

TECHNOLOGY DEPT.

THE Chemical Age

VOL. LXXI

16 OCTOBER 1954

No. 1840

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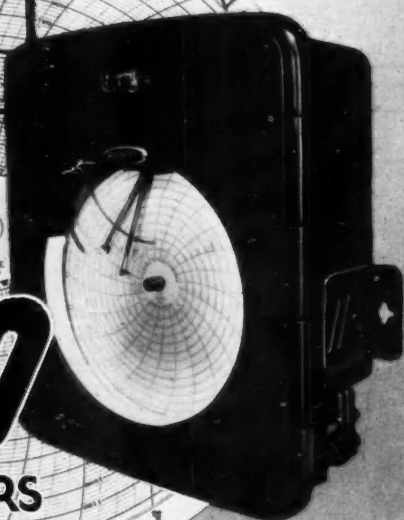
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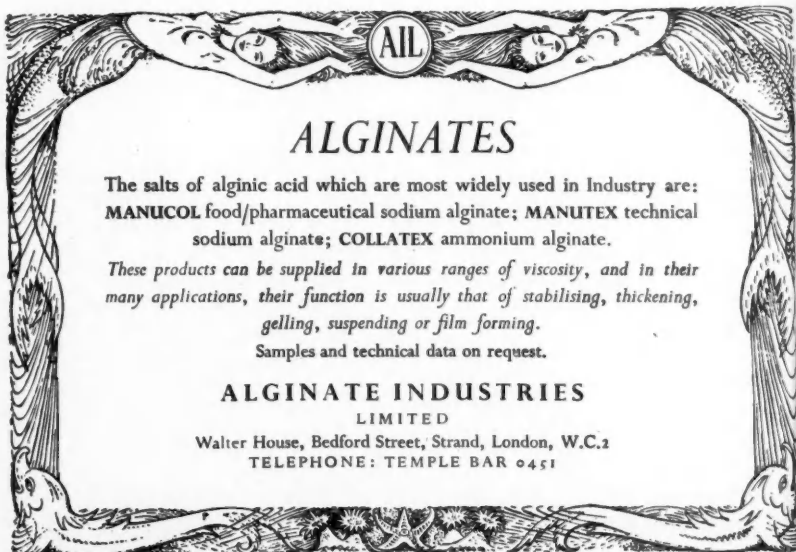
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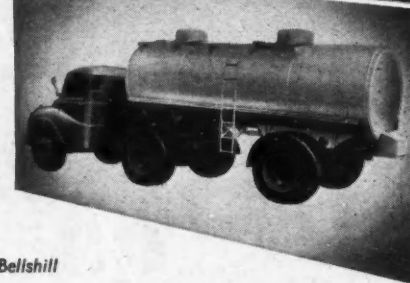
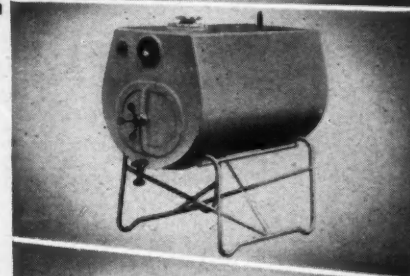
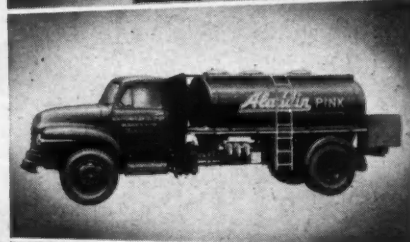
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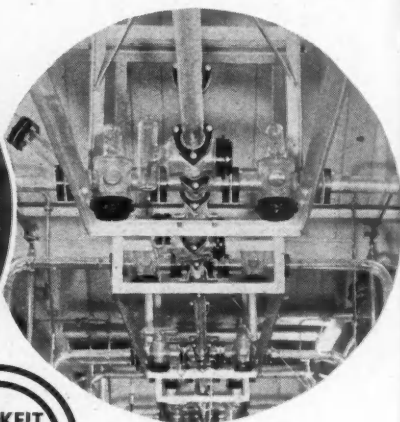
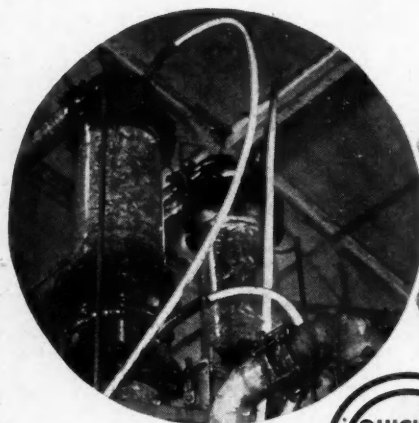
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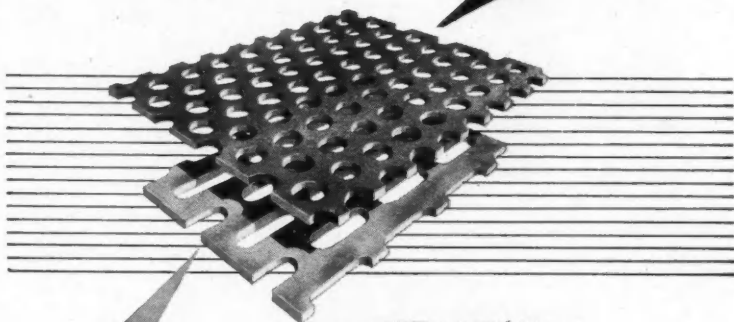
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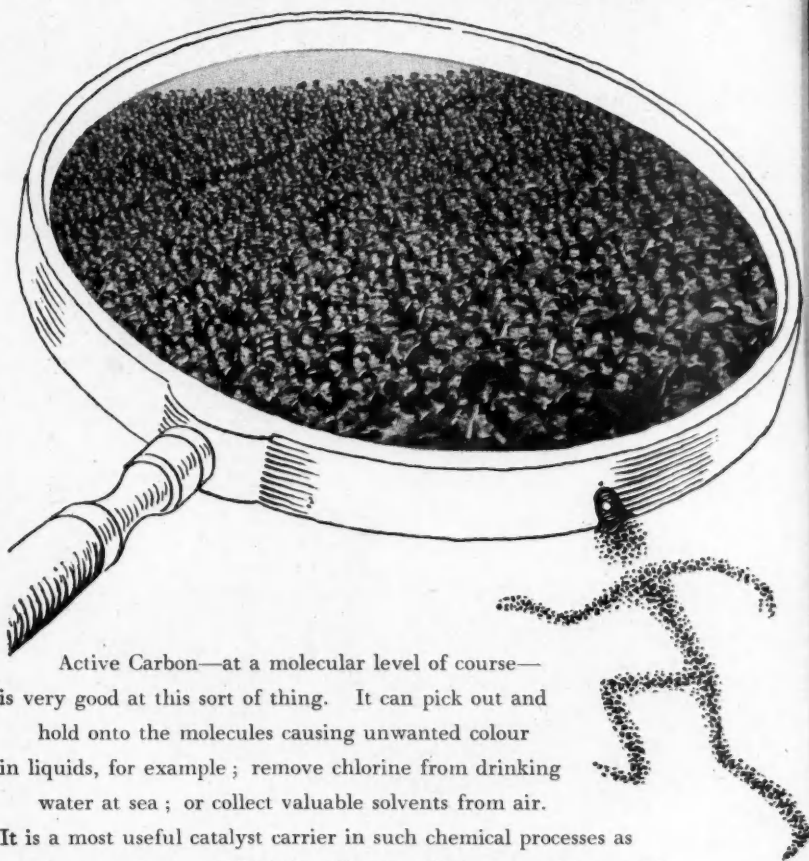
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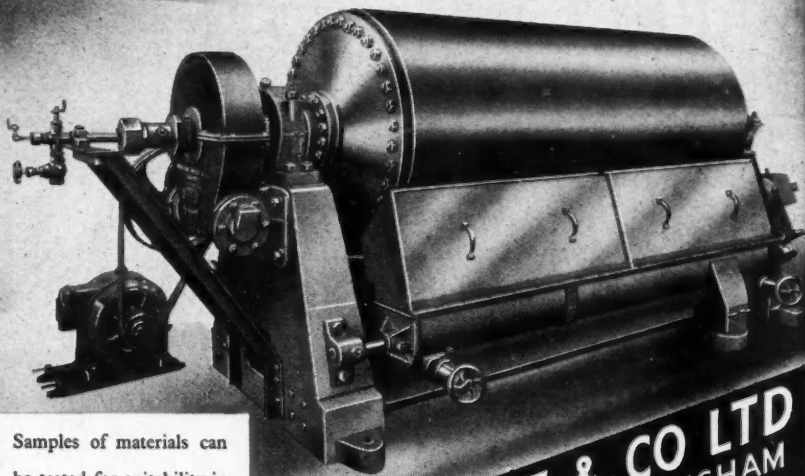
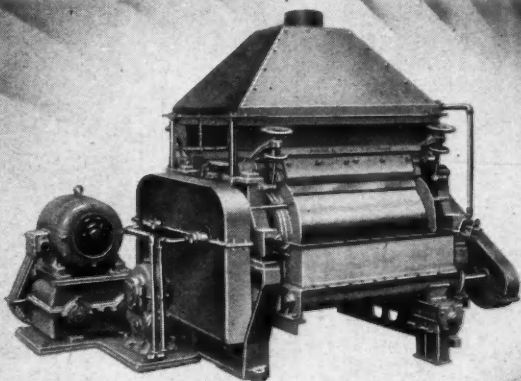
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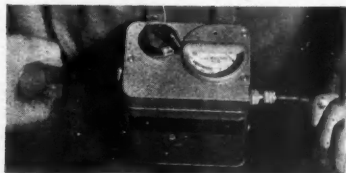


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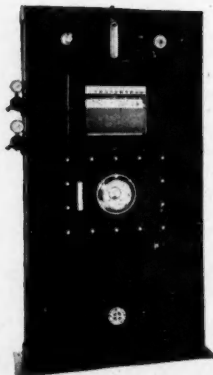
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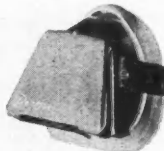


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CONTENTS · 16 OCTOBER 1954

Northern Flexible Centre	816
Silicones Plant at Barry	817
Symposium of Midlands Society for Analytical Chemistry	821
Labour Turnover—A Current Problem	831
Unusual Exchange Resin	835
New US Titanium Plant	836
Oil-Based Paints	837
Tube Drawing Tower	838
The Chemist's Bookshelf	839
Home News Items	841
Overseas News Items	842
Personal	843
Publications & Announcements	845
Law & Company News	846
Market Reports	847
Next Week's Events	848

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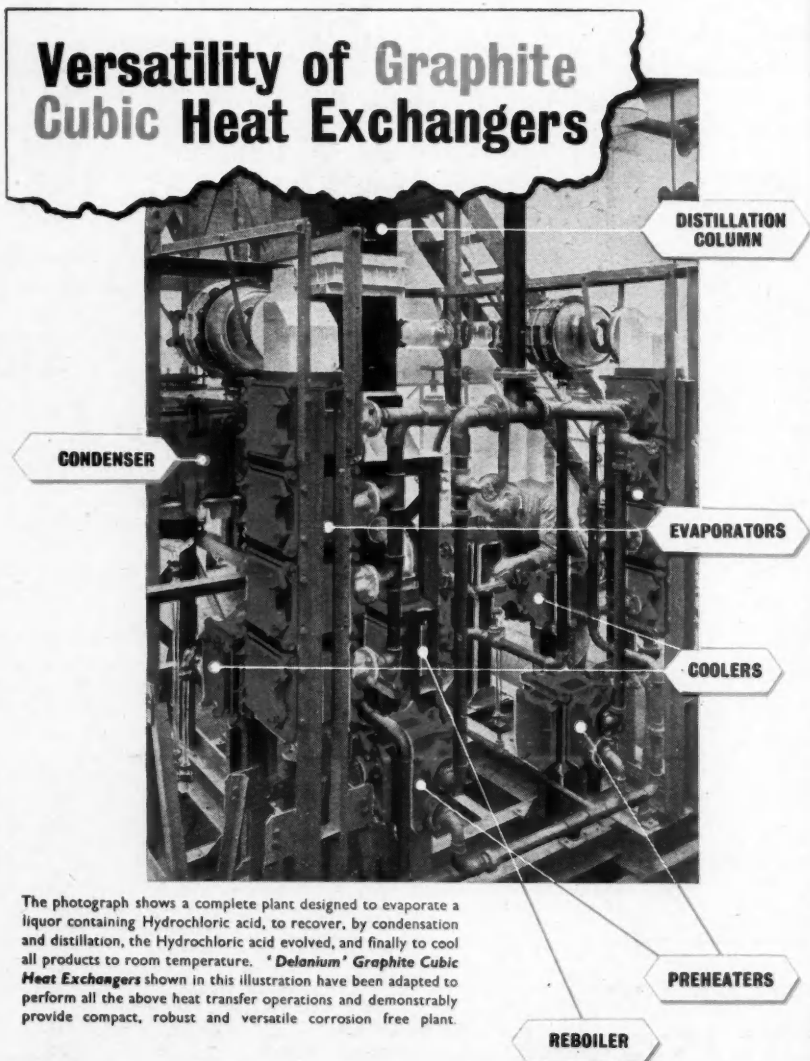
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Industry v. Pests

A BRANCH of the chemical industry seldom written about is that of pesticide manufacture and distribution. It is surprisingly neglected, for its activities today have become exceedingly varied and few branches of the chemical industry have passed through so many revolutionary changes in so few years. Nothing can remain static for long in the complex war between man and insects: the insect seems always able to fight back and victories are local and temporary.

Trade in plant protective substances has a fairly long history. In the mid-eighteenth century French newspapers advertised remedies for 'plant lice,' and nicotine as an insecticide was sufficiently known for a tobacco extract and a syringe for applying it to be described. Certainly the nineteenth century did not see the beginnings of the industry in Europe; remedies for this or that attack of pests on crops had already been paraded, although most of them were on a small scale and based upon secret formule. In any case, remedies for the insect pests of man and animals had been given more attention in an age when not even the most royal of palaces was certain of freedom from the flea and the bed-bug; apothecaries of the seventeenth century did a brisk trade in products claimed to repel or kill the creeping parasites of man. But so long as the needs of the population to be fed did not seriously exceed the productive powers of the available acreage, and so long as it was accepted as a law of destiny that poor people must starve or nearly starve in 'bad years,' remedies to reduce the harvest losses caused by crop parasites were not likely to attract an equal interest.

The nineteenth century brought a

markedly changed background. Davy and Liebig had given the first real shape to scientific agriculture; and in the Hungry Forties not only Ireland but much of Europe suffered grievously from the ravages of potato blight. The cheap movement of bulky foodstuffs across oceans was yet to come, and most countries were still self-dependent. The farming and gardening journals of the 'forties contained a diversity of advertisements for slug killers, mealy bug exterminators, etc., and even if remedies were more hopeful than certain, the fact that they were offered shows that a demand for pest-control products had come into existence. The widespread introduction of the garden greenhouse during the Victorian era created climatic sanctuaries for insect pests as well as rare plants in every well-to-do road. Fumigants were badly needed; the invasion of pests was only too evident. Tobacco extracts were much used and in the 'eighties a young man named Richards, who worked at Kew, thought it worth while to standardise such a product, which he called 'XL Nicotine'; and the London firm he founded to make and sell the product is still in active existence.

Some three or four decades earlier another young man of foresight, Cooper, a veterinary surgeon, had begun a new business making and selling an arsenic-sulphur combination for treating sheep-scab; within fifteen years he had also introduced seed dressing preparations and by 1870 it is said that he was selling enough of these to treat the cereal seed for 100,000 acres a year.

The discovery that 'bouille Bordelaise'—aqueous copper sulphate plus lime—could protect the potato plant from the spores of blight gave a huge impetus to

the idea of using chemicals to avoid 'natural' plant damage and losses. The subsequent demand for this type of product no doubt stimulated the chemical industry to consider the potentialities of the general pesticides market. Soon after 1900 a number of new firms entered the field. Quassia sprays were introduced for hop-gardens. Derris, long used in China and Malaya, was introduced both for sheep-dips and garden pest control. A mercury salt was introduced for killing worms in lawns. Arsenate of lead, which was to be the major fruit-pest killing product for many years, made its way from America to England. Chemical complexity was already manifesting itself. Though it was the custom of farmers to rely as far as possible upon simple materials they could make for themselves, most of the new products required careful factory preparation.

By 1911 a veritable 'pharmacopoeia' of substances and formulations existed for the protection of crops. This particular date is chosen because in that year the famous French book, 'Les Maladies des Plantes,' by Dr. Bourcart, was published, a lengthy and detailed scientific catalogue of many hundreds of products, some well tried, some little tried, all of them with some reason for being listed and discussed. Not many of the products described then are still in use today. The 'pharmacopoeia,' and the industry, has been transformed beyond recognition. Bourcart's once famous book is a dead work, but it remains as an historic landmark. At no other time was the contemporary position of the industry and its offerings so clearly presented.

Between the wars competition intensified, and this helped to stimulate a number of advances, particularly in formulation. Liquid derris sprays were introduced; more concentrated copper products were developed in the place of 'bouille Bardelaise'; organo-mercury products entered the seed-dressing field; even the application of sprays from the air was pioneered, for in 1922 lead arsenate was dusted on to a Kentish orchard from an aeroplane. Competition forced firms to initiate their own research instead of relying mainly upon developments at the independent agricultural or horticultural centres. A few of the older

companies merged; and at much the same period some of the bigger chemical companies, previously only indirectly concerned with the pesticide trade, decided to develop direct interests. Imperial Chemical Industries, Boots Pure Drug Co., and the Shell Oil Co. might be particularly mentioned. Within a few years the pesticides interests of I.C.I. were to be linked with those of one of the older firms, itself a product of previous merging, in the creation of Plant Protection Ltd. A little later, Dr. Ripper came from Austria and introduced new techniques in the use of nicotine; his success led to the formation of Pest Control Ltd., now acquired by the Fison group.

It is inevitably invidious to mention the names of specific firms, but the shaping of a vigorous and ever-changing branch of industry cannot be described entirely in abstract terms. Over-all statistics about the British industry are more notable for their gaps than for their figures, though it is known that total world trade in pesticides already exceeds a wholesale value of £100,000,000 per annum. The export trade of the British industry is certainly substantial; it is not a new development but one that goes back to the 'twenties. As a most cautious estimate it can be assumed that British pesticides secure a reasonable share of world business. The value of exports in 1938 was said to be £961,000; in 1949 it had risen to £3,000,000, and 1949 is somewhat early in the post-war years to give the best indication of British industry's overseas prospects.

The leading manufacturers have established their own research centres and field stations. Comparison with the US industry's activities in the same direction might make the British research effort seem somewhat small, but the American home market is much larger; it is also possible to argue that there has been excessive research investment in the US in this swiftly changing field of applied science, investment on a scale which cannot be maintained.

The British pesticides industry is still youthful, still being shaped; it seems a safe enough prediction that its future is bright, particularly in overseas trade.

Notes & Comments

Loyal . . .

FOR various reasons many people still look upon Government-sponsored international organisations with contemptuous amusement. Unfortunately the people who believe in even such a worthwhile set-up as the OEEC are in the minority. It could, therefore, reasonably be expected that those who laboured on behalf of such an organisation would soon become discouraged and bitter, for what can be more dispiriting than trying to help those who not only will not help themselves, but resent your offer of aid? This does not seem to be the case, however. At a reception held by the DSIR on 28 September, certain editors of the British Technical Press were given the opportunity of informally mixing with officials of the European Productivity Agency of OEEC as well as National Technical Information Services Officers from several OEEC countries. The enthusiasm and faith of these people in their work and in the organisation proved quite contagious. This is not to say, however, that they do not recognise the magnitude of their task or the difficulties which face them. They believe, however, that suspicion and apathy are gradually diminishing while the co-operation from industry is increasing.

. . . But not Blind

A N American chemist of wide experience recently expressed the opinion that two big obstacles in the path towards increased productivity by Europe's chemical industry are an ingrained secrecy and the failure on the part of management to recognise the importance of research. Many continental chemical manufacturers refuse to allow strangers to visit their works even when the purpose of their visit is to assist in increasing output. They do not want anyone to know either what they are doing or how they are doing it, although they are anxious to know all about other firms both at home and abroad. This lack of faith and unwilling-

ness to share knowledge is handicapping not only the industry but the nation concerned. In so far as research is concerned, many companies (notably French) fail to realise that research is imperative in this chemical age. Even those who do maintain research departments are very slow in applying the knowledge gained. In certain cases firms appear to have research departments purely for prestige purposes and management has no intention of making practical use of the efforts of research workers. As one member of the EPA said last month, before the Productivity Agency can achieve its objects management will have to be educated. They will have to realise that first they must help themselves and then that increased productivity is designed to help the nation as a whole and not just the management of one company. In the US when workers or productivity experts discover some way in which output can be increased or costs can be lowered, the workers share in the financial gain which follows. In certain European countries, however, we are told all that results in increased profits for the owners.

New Films

I N the United States polyethylene terephthalate is about to assume large-scale production in the form of film. The \$10,000,000 Du Pont plant in Ohio is practically completed; some film has already been made and distributed. The extrusion of polyethylene terephthalate as a film gives an amorphous product without any unusual properties; ordinary heat treatment merely causes a crystallisation on cooling that converts the transparency of the film into opacity. A treatment that entirely re-orientates the film as initially extruded is needed to produce 'Mylar' polyester film with its impressive list of exceptional virtues. An excellent theoretical account of Mylar's development will be found in *Chemical & Engineering News* (1954, 32, 3724). The new film seems likely to invade the cinema industry on a wide front. It has all the safety qualities of acetate film, but

much greater durability and dimensional strength than either acetate or nitrate film. It is estimated that it may be possible to reduce the thickness of cinema film by as much as 20 per cent; reels will have a longer 'footage', handling costs will be lowered, and the working life of a film is likely to be three or four times longer. The film and photographic world is only one target for the new synthetic film, however. It has a high tensile strength and a high dielectric strength; its mechanical properties are maintained over a wide temperature range (-60° to 150° C.). It is resistant to moisture and solvents, and can be affected by only a limited number of acids and alkalis. Such properties suggest that the film will develop a wide range of industrial uses, such as electrical insulation, recording tapes, lining material for drums to hold corrosive substances etc.

New US Textile Fibre

THE Celanese Corporation of America has announced that commercial production has begun of a new textile fibre made from wood pulp by an acetate process. The laboratory name was 'X.100,' but the fibre will be marketed as 'Arnel.'

Production is at first being concentrated on the staple fibre which will be sold at 55 cents per lb. This compares with the US price of 45 cents per lb. for ordinary acetate staple, but it is considerably cheaper than

the staples of most of the newer synthetic fibres.

The process, according to the *Wall Street Journal*, is based on cellulose triacetate. Fabrics made from the new fibre are said to feel like silk to the touch and to drape like it but in other ways the material is more like nylon or Terylene than viscose or acetate rayon.

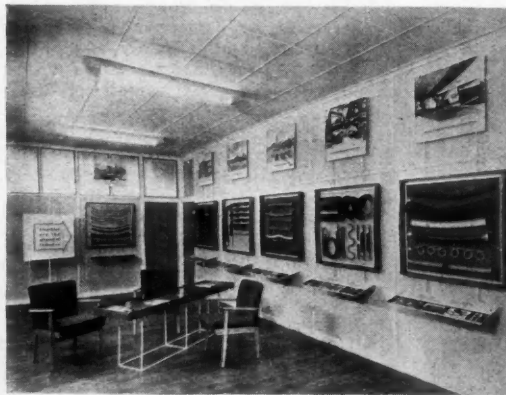
Northern Flexible Centre

TO MEET the heavy demands made on the advisory service of Compoflex Co. Ltd. by industry in the Midlands and North of England, the company has opened a Northern Flexible Centre at their factory in Huddersfield Road, Oldham.

The centre, which was officially opened on Wednesday, 6 October, by Mr. Ian Horobin, Member of Parliament for Oldham East, is staffed by a team of specialists able to give advice on the most suitable flexible tube or hose to use in any given situation. A development section has also been started in Oldham, to deal with the design of special flexibles for particular projects.

On the walls of the new centre are large photographs representing each branch of industry, with the various flexibles used in that branch displayed beneath.

The first Flexible Centre was opened by Compoflex Co. Ltd. at their head office in London in 1952, and their advisory service has since proved so popular that the opening of an additional centre in the North has become essential.



The Northern Flexible Centre at the Oldham factory of Compoflex Co. Ltd.

Silicones

**Now Made in Britain
at New Barry Factory**



Blending silicone rubber stock

SILICONES, those versatile materials of increasing use and importance, are now being made in Britain at the Barry plant of Albright & Wilson Ltd. Details of the plant and process were first made public on 6 October.

Although silicones were introduced to this country in 1945, and Albright & Wilson began importation of Dow Corning products in the following year, it was only last year that production was begun at Barry, and the plant is still incomplete and not yet in full production. However, Britain will now be independent of dollar sources, and expanding home production should keep pace with growing home demand, as well as meeting demands in an already promising export market.

The site, which was purchased in 1950, was formerly the plant of the Ocean Salts Manufacturing Co. Ltd., which had been erected during the war for the extraction of magnesium salts from sea water, and which ceased production shortly after. The office and laboratory blocks were put into immediate use, and although the use of existing factories presented serious problems to the chemical engineers responsible for the design of the plant, in certain cases the facilities already available on the site proved of considerable value. For instance, the concrete bases of the sea-water thickeners have made ideal bunds for the tank farm and distillation plant.

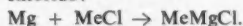
The general sequence of processes carried out at Barry is as follows: A mixture of pure silicon metal (generally imported from

France or Sweden) and copper chips is fed slowly through a rotary kiln heated to 275-375°C, in an atmosphere of methyl chloride. This results in the formation of Me_2SiCl_2 , together with MeSiCl_2 , MeHSiCl_2 , Me_2SiCl , SiCl_4 and HSiCl_3 . These chlorosilanes are condensed by water and by refrigerated brine, the methyl chloride stream is compressed, and any residual chlorosilanes are recovered as bottoms from a flash still.

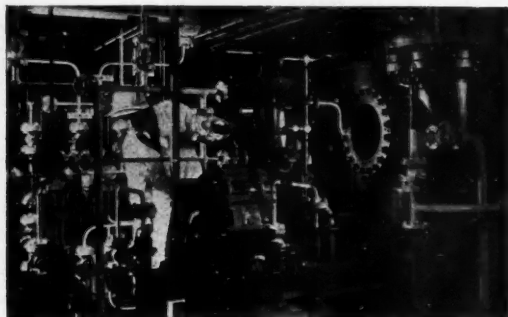
The products are then piped to the distillation unit. In the first column low boilers are taken off at the top, and in the second high boilers are removed at the bottom. Rough separation of mono- and di-methyl derivatives takes place in the third column, and the fourth is a long fractionating column, with a very great number of theoretical plates, which is about 100 ft. high, and has had to be divided into two.

Methyltrichlorosilane, which is of minor importance, is produced in too great a yield. It is therefore further methylated by means of a Grignard reaction. The development of this well-known laboratory procedure to industrial scale was a major achievement on the part of Dow Corning.

Magnesium chips are turned from billets on an adapted lathe with air cooling, and transported in drums to the Grignard plant. Here they are added to a pressure vessel containing ether, and allowed to react with methyl chloride:



When the reaction is complete, the Grig-



Some of the intricate pipeline installation in the chlorosilane production plant

nard reagent is diluted with toluene and reacted with the chlorosilane:

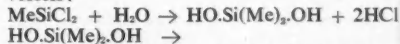
$\text{MeMgCl} + \text{MeSiCl}_3 \rightarrow \text{Me}_2\text{SiCl}_2 + \text{MgCl}_2$.
The solution is filtered, and the reaction products returned to the distillation unit. Later, phenylation of chlorosilanes is to be carried out in the same way.

Stills remove ether and toluene from the Me_2SiCl_2 , which is then fed into the fractionating column. Three further stills are used for the purification of ether, and there are six batch stills for various products. The distillation unit is provided with a complete auto/manual graphic control panel, containing some 17 miles of tubing, which is claimed to be the largest of its kind in Europe.

The purified products are stored on the tank farm until they go forward to the remainder of the process. Here also the methyl chloride is stored—in tanks over which water pours continuously during

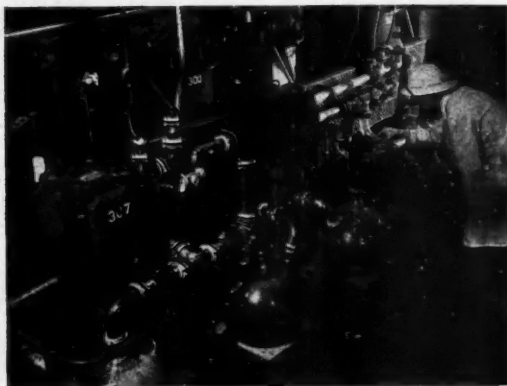
warmer weather to keep the temperature below 20°C.

Chlorosilanes in required proportion are taken from storage to the hydrolysis plant, where they are hydrolysed in Pfaudler glass-lined kettles and washed with hot water and alkali to remove hydrochloric acid. A controlled degree of polymerisation is obtained by passing the hydrolysate through heated vessels:



A certain amount of cross-linking can be obtained by the incorporation of some MeSiCl_3 .

After polymerisation, the liquids are stripped in a still at 5 mm., the top providing a low viscosity silicone oil. The bulk of product becomes the range of MS200 silicone fluids, for use in instruments, as dielectrics, hydraulic fluids and lubricants,



Part of the hydrolysis unit

and many other applications. They are carefully blended to give the correct viscosity, which may be anything in the range 0.65 to 3,000,000 cs.

Silicone rubber stock and greases are readily compounded by further polymerisation of a suitable MS200 fluid, followed by the addition of an appropriate filler. Silicone resins are obtained by making use of the cross-linking properties of MeSiCl_2 .

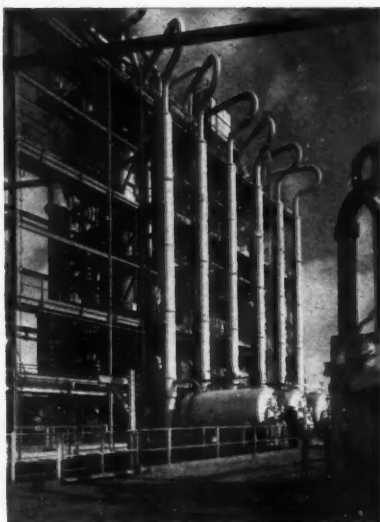
The laboratory block contains a well-equipped technical service department, which advises consumers on the applications of silicones and investigates new uses,



Part of the graphic control panel of the distillation unit

and the works laboratory. This latter possesses a small-scale replica of the distillation unit, in which complete analyses can be carried out. These, however, may take up to three days for a single run, and for rapid analysis a Grubb-Parsons twin beam IR spectrophotometer is employed.

The handling of the hazardous and highly reactive intermediate products and solvents used in silicone production presents considerable difficulties, since in all stages of the process the entire system has to operate in anhydrous conditions. Moreover, elaborate safety precautions are necessary, and the solvents and products are stored in buried tanks. All parts of the system are purged with inert gas to prevent the ingress of air or moisture and to reduce the risk of fire.



Close-up of the distillation unit showing still-pots and batch columns

Incoming solvents are transferred to tanks by pumps, but methyl chloride is moved throughout the system by utilising its own vapour pressure. All people working in hazardous areas wear helmets and glasses.

The plant was designed by Albright & Wilson's own central engineering department, and based on full working drawings provided by Dow Corning, who have given every assistance.

The cost of the plant was about £1,500,000, and it is designed for a throughput of 600 tons a year. At present the factory produces 30-40 per cent of the silicone compounds sold by Midland Silicones, the rest being imported, chiefly from America. At capacity the plant should be supplying 95 per cent of the company's sales. The only other European countries to possess full-scale silicone manufacturing plants are France and Germany.

Fuel Minister Visits Stanlow Refinery

Mr. Geoffrey Lloyd, Minister of Fuel and Power, visited the Shell refinery at Stanlow, Cheshire, on 7 October. At the end of his tour he said that the oil industry was one of the most dynamic and progressive in the World.

East-West Trade

New Order Relaxes Export Controls

RELAXATION of controls on goods exported to the Soviet bloc (not including China) will come into effect on 20 October, under an export licensing amendment order. The general effect of the order is to reduce the embargo list by about 80 items and the quantitative control list by about 70 items and to enlarge the area of permitted trade in a large number of categories—including chemicals and chemical plant—remaining under control. At the same time a few new strategic items have been added to the embargo list.

Licences are not now required (except for exports to China, Hong Kong, Macao and Tibet) for carbon, celestite and strontianite, natural graphite and scrap, polydichlorostyrene, specified ferro-alloys, carbon steel plates, certain forms of non-ferrous metals and alloys, specified ores and concentrates, certain manufactures of platinum chemical process vessels, certain cocks and pipe valves, gauges, steel tanks, air conditioning machines, freeze-drying plant, certain heat exchangers, heater return bends, water treatment plant, certain metal working machines, certain co-axial cable machines, electro-static precipitators, furnaces (other than vacuum furnaces), micro-hardness testers, mineral separation plant, pyrometers, strain gauging equipment, Warburg apparatus, certain chemicals and drugs, certain scientific equipment and articles containing silver.

Licences are now required for the export to all destinations of mercury metals and alloys and certain chemicals and to all destinations except the British Commonwealth (excluding Hong Kong), Eire and the US of certain nickel steel alloys and specified chemicals. Full lists of controlled goods can be obtained from the Board of Trade, Commercial Relations and Exports Department, Horse Guards Avenue, London, S.W.1.

Scientific Research

International Symposium on France

THE problems of organisation and administration of scientific research in Europe have been studied by European specialists at an international symposium which has been taking place at the University of Nancy from 11-15 October.

This international symposium has been

organised by the European Productivity Agency of the OEEC and the Rector of the University of Nancy, who acted as secretary-general, with the assistance of the French Ministry of Industry and Commerce. It follows up a first international study session convened by the OEEC in London in November, 1952, as the result of a technical assistance mission which studied the organisation of research in Europe.

The aim of this international symposium was to enable representatives of government bodies, university teachers and European industrialists to study the progress achieved by member countries in the administration and organisation of scientific research, and means of developing co-operation for the furtherance of applied research between national bodies, industries, and higher educational establishments. It should also encourage closer relationships between experts dealing with a subject considered to be of increasing importance by all countries.

Delegates from Austria, Belgium, France, Germany, Italy, the Netherlands, Norway, Sweden, and the United Kingdom attended the symposium. The United States, Australia, Canada, India, New Zealand, the Federation of Rhodesia and Nyasaland, and the Union of South Africa were also represented.

New British Standards

THE British Standards Institution has just issued the following three further standards in its series of standards for solvents and allied products, which now totals 36 standards: BS. 2533 (Chlorobenzene); BS. 2535 (Dibutyl Sebacate); and BS. 2536 (Di-2-ethylhexyl Sebacate). Limits are specified for the physical properties of the materials and for impurities likely to be present, and full details of the method of analysis are given.

Among the Government departments and other organisations represented on the committee responsible for the preparation of these standards were: Board of Trade; Ministry of Health; Oil and Colour Chemists' Association; National Paint Federation; Society of British Paint Manufacturers Ltd.; Association of British Chemical Manufacturers.

Copies of these British Standards can be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1. Price—2s. (BS. 2533 and 2536) and 2s. 6d. (BS. 2535).

MIDLANDS SOCIETY FOR ANALYTICAL CHEMISTRY**1954 International Symposium**

ALTHOUGH the Midlands Society for Analytical Chemistry was formed only in 1950, by September 1952 it had sponsored a two-day International Symposium on Analytical Chemistry at the University of Birmingham. The success of this meeting, as shown by the attendance of many distinguished chemists from both home and abroad and the high standard attained in the papers presented, encouraged the Society to hold a second and larger symposium this year from Wednesday, 25 August to Wednesday, 1 September, at the same venue. Preparations were begun well in advance by an extremely hard working committee, and the scope of the 1952 symposium was considerably enlarged.

When the proceedings were opened by the Symposium President, Professor H. W. Melville, F.R.S., Mason Professor and Head of the University of Birmingham Chemistry Department, in the main chemistry lecture theatre, he was addressing an audience of over 300 delegates, of whom at least 50 were from abroad. Countries as far apart as the US and Brazil on the one hand, and Finland and Czechoslovakia on the other, were repre-

sented, so that the symposium was well worthy of being termed an international one. After welcoming all the delegates to Birmingham, Professor Melville said he hoped this symposium would be even more successful than its predecessor.

The lecture sessions, apart from the plenary lectures, were divided as far as possible into three groups: (1) recent advances in industrial analysis; (2) recent advances in special branches of analysis; and (3) accounts of original investigations.

This classification proved to be a successful one, since it enabled delegates interested in related subjects to hear them in the same lecture theatre throughout the entire symposium. All the many branches of analytical chemistry were covered by the papers, and the high standard achieved at the 1952 symposium was more than maintained by the speakers. The lectures were well supplemented by demonstrations, exhibits, and films, and these helped to give the audiences a better insight into the material presented.

The lecture programme commenced with the Symposium Honorary Chairman, Professor F. Feigl, giving the first of the four



Famous analytical chemists from four countries: Professor P. W. West (Louisiana, US), Dr. R. Belcher (Birmingham University, Symposium Secretary), Professor Claude Duval (France), J. R. Leech, J.P. (Joseph Lucas Ltd., chairman, Midlands Society for Analytical Chemistry), and Professor F. Feigl (Brazil)

plenary lectures. It was entitled 'Progress of Organic Spot Test Analysis Based on Experiences with the Chemistry of Specific, Selective, and Sensitive Reactions.' After an introduction in which he indicated the potential scope of organic spot test analysis, Professor Feigl gave details of several new spot tests'. These included extensions of already well known tests for compounds containing 8-hydroxyquinoline, for compounds containing α -situated hydroxyl and aldehyde groups, and for 1,2-diamines, primary and secondary amines, and recently devised tests for coumarin, chloranil, oxamide, and the detection of carbon in a compound.

Iron & Steel

Following the opening of the symposium in the morning, the three lecture sessions commenced in earnest in the afternoon. Mr. B. Bagshawe, of the Brown-Firth Research Laboratory, gave an account of 'Recent Advances in the Analytical Chemistry of Iron and Steel' (Session 1). In the Special Branches Section (Session 2), Mr. H. Holness, from the South-West Essex Technical College, London, lectured on 'Recent Advances in Qualitative Analysis.' He outlined his recently published scheme of semi-micro qualitative analysis', in which the classical hydrogen sulphide procedure is modified to include all the elements likely to be encountered in modern analytical practice.

Some of the main points to be noted about this scheme were the introduction of an entirely different Group I, replacement of the classical ammonium polysulphide reagent by a lithium hydroxide solution to give a clean separation of the copper and arsenic sub-groups³, recognition of the behaviour of tungsten in forming complex acids and the allowances to be made for this, modification of an existing method of phosphate removal to deal with both phosphates and complex tungstates, and alteration of the Group III precipitation procedure to minimise the loss, by precipitation as carbonates, of some of the alkaline earth metals. A portable set of semi-micro apparatus designed for use in conjunction with the analytical scheme was on view.

Dr. R. Pribil from Czechoslovakia was unable to be present at the Original Investigations Section (Session 3) to talk on 'Recent Advances in Chelatometry,' as he was detained by passport difficulties. In his absence, Dr. H. Flaschka from Graz, Austria,

spoke on 'Some Recent Advances in Complexometric Titrations.' His opening remarks were concerned with the original alkalimetric methods, which were rather restricted in their scope, however. At pH 2-3, for example, ferric ion can be titrated in the presence of magnesium and calcium, since the complexes of the two latter ions are less stable than the former.

The field of complexometric titrations had since been widened by the introduction of masking agents, such as cyanide and triethanolamine, the use of precipitants, as in the case of fluoride for the precipitation of calcium and aluminium in the determination of zinc, and finally the application of specific indicators, which are only of value for metals with high complex constants, e.g. Th, Bi, Fe.

Dr. Flaschka's lecture was followed by one on 'Photoelectric Complex Formation Titrations'. Under this heading, Professor A. Ringbom, of the Abo Academy, Finland, gave the general principles of complex formation titrations using metal indicators. Briefly he derived the mathematical equations necessary for the exact determination of the equivalence-point with one-colour and two-colour indicators, and suggested a method for preparing a comparison solution of exactly the right composition; he also discussed the influence of various factors on the titrations, and described some titrations of copper and magnesium with EDTA to illustrate the accuracy attainable in practice.

Paints & Varnishes

Since the afternoon of the Thursday was devoted entirely to visits to local industries, lectures were only held during the morning. In Session 1, Mr. C. Whalley, of the Paint Research Association, detailed some 'Recent Advances in the Analytical Chemistry of Paints and Varnishes.' The three principal components of the paint system—the solvent or diluent, the medium, and the pigment—were considered separately. Stress was laid on the analytical examination of failures, micro-chemical methods being essential in this connection.

Dr. J. C. Robb, of the Physical Chemistry Department, University of Birmingham, talked on 'Recent Advances in Mass Spectrometry' at Session 2. Although this analytical method had been applied largely to the analysis of hydrocarbons, Dr. Robb discussed in some detail a wide range of

analytical problems which can be solved quickly and accurately by this technique, e.g. investigation of high molecular weight oils and waxes, isotope analysis of solid inorganic materials, and analysis of residual gases in vacuum tubes. It is also practicable to use a mass spectrometer of special design for the close monitoring of plant and plant control.

For the morning's Accounts of Original Investigations, a survey of 'Recent Advances in Qualitative Inorganic Analysis' was given by Dr. R. Belcher, Reader in Analytical Chemistry at the University of Birmingham. His material was grouped under the headings of primary standards, indicators, reagents, and modifications of established methods.

The lecture programme for the morning was brought to a close by Professor M. Stacey, F.R.S., Professor in charge of Organic and Biological Chemistry at the University of Birmingham, who delivered the second plenary lecture, entitled 'The Development of the Birmingham Analytical School.' Professor Stacey said that the chemistry professors at Birmingham had always believed in the discipline of accurate analysis, and had subjected their students to stern requirements and high standards in this respect. Emphasis had been laid on both the inorganic and organic aspects of the subject.

The routine micro-laboratory was set up before 1930, and the micro-analytical techniques were being taught to the undergraduates by the mid-thirties. After the war industrialists were of the opinion that insufficient provision was being made for analytical training in the department, and as

a result a senior lectureship was established in analytical chemistry. Dr. R. Belcher was appointed to this post in 1948, and from a small beginning at that time, the analytical school had since grown to be one of the most important in the world.

Friday provided the first full day of lectures. The Industrial Advances began with Dr. D. Dickinson from the Canning Research Association speaking on 'Recent Advances in the Analytical Chemistry of Foods.' Mr. Dickinson did not deal with advances in the actual techniques for the analysis of foods, but adopted a more general outlook in his lecture. He was concerned mainly with a new set of standards which is being set up to define the limit of impurities, such as lead, in food materials, and discussed the effect this would have on the methods employed in food analysis.

Next Mr. H. Bennett, of the Ceramics Research Association, reviewed 'Recent Advances in the Analytical Chemistry of Ceramics'. Finally, Dr. R. A. Mott, of the Midland Coke Research Station, Sheffield, gave an account of 'Recent Advances in the Chemistry of Coke and Coal.' He dealt with the preparation of samples of coal and coke for analysis, showing how errors could result from this. Recent developments in the ultimate analysis (C, H, N, S) of coal had enabled improved methods to be adopted in the revision of BS.1016:1942, 'Analysis and Testing of Coal and Coke.'

The special Branches Section commenced with Dr. F. H. Pollard, Reader in Inorganic Chemistry at the University of Bristol, outlining 'Recent Advances in Inorganic

J. Kinnunen and Professor A. Ringbom from Finland with Professor F. Burriel-Marti from Spain



Chromatography.' A brief discussion of the general requirements for adsorption and partition chromatography, and the techniques employed in them, was followed by the mention of schemes for the qualitative analysis of unknown mixtures of cations and selected examples of recent work where paper and cellulose columns were used in quantitative analysis. The use of electrochromatography for discontinuous and continuous separations was pointed out. The lecture was well illustrated by coloured slides and demonstrations.

Advances in Polarography

Following Dr. Pollard's lecture, Dr. W. Cule Davies from Brothertons, Leeds, detailed 'Recent Advances in Polarography.' Session 2 was closed by Dr. R. L. Mitchell, of the Macaulay Institute for Soil Research, Aberdeen, who surveyed 'Recent Advances in Spectrochemical Analysis.' Trends in instrumentation had been towards the development of high dispersion equipment, and in infra-red work double-beam instruments were now available. The introduction of the KBr pressed-disc technique had provided a simple and efficient means of obtaining the infra-red spectrum of solid materials. A widely employed development in emission spectrography was the use of rotating disc electrode methods. A survey of the spectrochemical methods employed in metallurgy in the US showed there to be little uniformity in the proposed methods, and each problem must still be considered on its own merits.

At Session 3, Dr. D. Gibbons, now at the Atomic Energy Establishment, Harwell, read his paper on 'The Determination of Sulphur in Steel'.⁶ The British Standards method for the determination of sulphur in steel, in which the sulphur is isolated gravimetrically as barium sulphate, had been considerably improved by applying the titrimetric procedure for evaluation of barium sulphate precipitates devised by Belcher, West and Gibbons'. In this procedure the barium sulphate precipitate is dissolved in a known excess of standard ammoniacal EDTA, and the excess back-titrated with a standard solution of magnesium chloride using Solochrome Black as the indicator.

The session was continued by Mr. H. Thomas, of the British Rayon Research Association, Manchester, who talked on 'The Determination of Potassium and

Sodium in Coal Ash'.⁸ After the ash has been decomposed by means of a Lawrence Smith ignition, the sodium is determined as sodium zinc uranyl acetate (gravimetrically or titrimetrically) on an aliquot of the aqueous extract, and the potassium gravimetrically as potassium tetraphenylboron on a second aliquot. Other methods for completing the determination had been examined, such as flame photometry, but these were less satisfactory.

During the afternoon Professor C. Duval and some of his colleagues from the Sorbonne, Paris, gave a series of lectures on spectrographic and thermogravimetric studies. In the first paper, Professor Duval together with Mr. J. Lecompte presented 'A Spectrographic Study of the $-XO_2$ Ions as an Aid to their Analytical Behaviour'.⁹ In the second, Miss C. Ott spoke on 'A Thermogravimetric and Spectrographic Study of Copper Hydroxides and Copper Oxide Hydrates',¹⁰ and in the third and last, Miss J. Jacquinot talked about 'A Thermogravimetric and Spectrographic Study of the Reactions in the Solid State between Metal Oxides and Sodium Peroxide'.¹¹

Monday again provided a full day of lectures. Dr. J. Haslam from I.C.I. Ltd., Plastics Division, opened the Industrial Advances Session by lecturing on 'Recent Advances in the Analytical Chemistry of Plastics.' No real co-ordination had yet been made for analysing polymeric materials, but Dr. Haslam attempted to cover as much of the ground as was possible in the time available. Most of the work that had been done was in connection with nylon-type polymers, but he also made mention of Terylene, urea-formaldehyde and vinyl-type plastics, etc.

Clinical Biochemistry

Mr. Garfield Thomas, biochemist at the Queen Elizabeth Hospital, Birmingham, continued the session by speaking on 'Modern Clinical Biochemistry.' Mr. Thomas gave a general review of the methods used in biochemical analysis today, e.g. chromatography, electrophoresis, fluorimetry, and illustrated them by demonstrations of the techniques and a display of specimens.

After lunch, Mr. E. Bishop from University College, Exeter, gave an account of 'Titrimetric Analysis of High Precision and Accuracy,' dividing his lecture into two parts:

(1) An examination of attainable preci-

sion—in which the accuracy attained by research workers when using the classical apparatus and technique of volumetric analysis had been determined and compared with that in the case of students. Good reproducibility was obtained between the two cases; and (2) a system weight titrimetry using arbitrary standards.

The session was concluded by Dr. T. B. Smith from the University of Sheffield, who delivered his lecture on 'Some Heinous Errors in the Theory and Practice of Analysis.' Dr. Smith defined the term 'heinous errors,' and then proceeded to detail various types of heinous and non-heinous error, illustrating each type by typical examples.

Radioactivation

Session 2 began with Mr. L. Salmon and Mr. A. A. Smales, of the Atomic Energy Research Establishment, Harwell, outlining methods for 'The Determination by Radioactivation of Traces of Alkali Metals in Materials of Geochemical Interest'.¹² This was followed by Dr. P. Hersch, of the Mond Nickel Co. Ltd., Birmingham, who gave a survey of 'Galvanic Analysis.' The technique was described in principle, and particular reference was made to the continuous galvanic oxygen meter, an instrument which had been improved recently. The meter may be used conveniently in research concerned with oxygen-uptake, -evolution, -diffusion, or -permeation. There are numerous industrial applications, such as control of protective atmospheres, recording of oxygen in high pressure boiling water, and possibly flue gas analysis. Mr. J. King, of the Government Chemistry Department, continued the session with a lecture on 'Quantitative Visual Colorimetry.'

In the afternoon Dr. H. Weisz from the Technical University, Vienna, outlined a new technique—'A Method of Separating Ions on a Single Drop'.¹³ With the aid of the ring furnace method¹⁴, it had been possible to devise a method of separation for the following cations: Pb, Bi, Cu, Cd, Sn, Sb, Fe, Co, Ni, Mn, Cr, Zn, Al and Ti. One drop of about 1.5 μ l. is sufficient for the analysis, the ions being separated on filter paper into four groups, designated as Ring I, II, III, and fleck. The identifications are conducted on the paper with the aid of familiar reactions, which, however, needed some slight modification for this purpose. The apparatus used in the separations was on view, and



Mr. H. Thomas (British Rayon Research Association, Manchester) and Mlle F. Weisbuch (France)

demonstrations of the techniques employed were given.

The Original Investigations Section was opened by Professor C. Duval and his colleagues, who presented two further papers in their series of spectrographic and thermogravimetric studies. These were 'A Thermogravimetric Study of the Dehydration and Rehydration of Some Complex Proteins',¹⁵ given by Professor Duval and Mr. L. Robert, and 'A Thermogravimetric Study of the Precipitates Formed between Dimendone and Aldehydes',¹⁶ by Professor Duval and Mr. N. Dat Xuong. These papers were followed by one on 'The Analysis of Chloroacetic Acid'¹⁷ given by Mr. L. F. Dupée and Mr. K. Gardner of Pest Control, Cambridge.

The session was continued further by Dr. G. A. Gilbert and Mr. R. Bottle of the Physical Chemistry Department, University of Birmingham, who talked on a method for 'The Estimation of Reducing Sugars by Alkaline Reagents with Special Reference to Dinitrosalicylic Acid Reagent'.¹⁸ The majority of saccharimetric reagents involve heating the sugar in alkaline solution, and oxygen is a competitor with these reagents. It had been shown in particular that im-

proved accuracy and sensitivity followed from the adoption of anaerobic conditions for the estimation of reducing sugars with Sumner's reagent (alkaline 3,5-dinitrosalicylate) and for Meyer's adaptation of the Sumner reagent to the determination of the molecular weight of starch fractions. In addition, under these conditions, the reagent had been used to determine very high molecular weights (i.e., very low 'copper numbers') with increased accuracy in a starch-type polysaccharide molecule and also to obtain information about the degree of branching of the polysaccharide molecule.

The afternoon session commenced with Mr. K. Sporek and Mr. A. F. Williams from I.C.I., Nobel Division, discussing 'The Chromatographic Separation of Penta-Erythritol and its Determination as the Dibenzal-Acetal.'

Amino Acids & Vitamins

Next Dr. A. Lacourt, and Messrs. G. Depaduwa and N. Delande, from the University of Brussels, talked on the 'Specific Identification of Amino Acids and Vitamins by means of Physical Constants.' Refractive indices and eutectic melting temperatures of binary systems had led to the specific identification of numerous amino acids and vitamins, for which compounds chemical identification was otherwise difficult. The identification is carried out under the microscope (Kofler method) with one or two crystals of material, the observation taking about one minute. It is possible to apply the technique to solutions and even to chromatographic spots located on paper. From the purely analytical point of view the technique could be extended to other functions in organic chemistry, while for routine and control work in both research and industry, it would be a rapid, accurate, and safe help.

Closing the day's lecture programme was the third plenary lecture by Professor M. K. Zacherl of the Veterinary University, Vienna. This was entitled 'The Impact of Microchemistry on Analytical Research.' In it Professor Zacherl traced the course of analytical chemistry since the introduction of microchemical techniques by Friedrich, Emich and especially Fritz Feigl in the early part of this century, and showed the debt that the modern analyst owes to the school founded by these the fathers of microchemistry.

Lectures were confined to the morning of the Tuesday, there being another afternoon

programme of industrial visits for all delegates. At Session 1, Mr. G. A. Vaughan from the Coal Tar Research Association surveyed 'Recent Advances in the Analytical Chemistry of Coal Tar.' Mr. Vaughan's lecture was followed by that of Mr. H. H. Collins of the British Cast Iron Research Association, who spoke on 'Operational Experience with the ARL Direct Reading Spectrograph (Quantometer).'

Professor F. Burriel-Marti from the University of Madrid opened the Special Branches Section with his paper on 'Heterogeneous Phase Redox Indicators and their Application.' He dealt with the effects of adsorption of redox indicators on to precipitates formed during titrations. Using numerous examples, such as the well-known zinc ferrocyanide titration, he pointed out the differences observed in the end-points according to which solution was used as the titrant.

Next, Professor F. Lucena-Conde of the University of Salamanca, Spain, gave an account of 'New Aromatic Amines as Reagents for Tungsten.' He said that of a great number of amines examined, 4,4'-diamino-triphenylmethane and 4,4'-diamino-3,3'-dimethyl-triphenylmethane precipitated tungsten quantitatively under certain conditions. The precipitates had been studied thermogravimetrically, and they appeared to have no definite composition, so that they must be ignited to the metallic oxide before weighing. Both amines could be used as redox indicators in volumetric analysis.

Inorganic Extraction Separations

The session was brought to a close by Professor P. W. West from Louisiana State University, who lectured on 'Extraction Separations of Inorganic Compounds.' Professor West stressed the importance of extraction separations as an analytical method, and then proceeded to deal with the technique of extraction for determination in some detail. As an example he illustrated the use of organic reagents to produce colours with inorganic compounds in organic media. In many cases, metallic ions giving no colour with organic reagents in aqueous phases do so in organic media, so that no predictions can be made concerning the colours likely to appear in organic media when those in the aqueous are already known.

Session 3 commenced with Miss A. M. G. Macdonald, of the University of Birmingham Analytical School, outlining 'Developments

in the Analysis of Organic Fluorine Compounds,' and in particular work recently completed in connection with the determination of sulphur and nitrogen. In the case of sulphur, the sample was fused with metallic sodium in a nickel bomb, and the sulphide so formed oxidised to sulphate. The latter was then precipitated as barium sulphate and evaluated by the previously mentioned titrimetric procedure of Belcher, West and Gibbons. For the determination of nitrogen, the Kirsten modification of the Pregl-Dumas method was applied. The conditions employed in this modification are more drastic, nickel oxide being substituted for copper oxide and the combustion temperature raised to 1,000°C. The accuracy of the sulphur method is ± 0.3 per cent, and ± 0.1 per cent for the nitrogen procedure.

Sulphur Determination

The session was continued by Dr. P. O. Bethge from Swedish Forest Products Research, who detailed 'A Wet Combustion Method for the Determination of Sulphur.' The wet oxidation is carried out with a mixture of perchloric and nitric acids²⁰, and then the remaining chlorine, nitrous gases, etc., are removed by boiling with hydrogen bromide. The residue is treated with a reducing mixture of hydrogen iodide and hypophosphorous acid, and the hydrogen sulphide produced, distilled off, and absorbed in sodium hydroxide solution. The hydrogen sulphide can then be determined^{21,22} by reaction with iodine solution and evaluation of the iodide so formed with standard thio-sulphate, or colorimetrically²³ by reaction with iodic acid and extraction of the iodine liberated with carbon tetrachloride.

Next, Dr. W. Schöninger, of Sandoz AG, Switzerland, spoke of 'A New Analytical Determination of Nitrogen in Organic Compounds'.²⁴ This was an extension of the method in which the organic substance is decomposed by ignition with magnesium powder in a small tube, the sulphur content then being determined iodimetrically by the Zimmerman distillation procedure, and the chlorine or bromine measured argentometrically by the Kainz and Resch modification of the Volhard method.

In the case of nitrogen, magnesium nitride is formed, and decomposed by mineral acid to yield the ammonium salt. The ammonia liberated on treatment with alkali is subsequently distilled off in a Kjeldahl appara-

tus, absorbed in an excess of standard acid, and the acid excess determined by back-titration with standard alkali in the normal manner.

Finally, Dr. G. Beck from the Medico-Chemical Institute, Berne University, talked about 'The Titration of Inorganic and Organic Compounds—especially Proteins—with Tervalent Copper (Percuprimetry)'. Potassium cupri-3-periodate and orthotellurate are strong oxidising agents, Dr. Beck said, and organic compounds are easily oxidised by them if they contain α -situated thiol-, hydroxyl-, or amino-groups, as in sugars (polyalcohols) and proteins (polyamines). The differentiated titration of proteins gives a characteristic bell-like curve, the shape depending on the structure and the manner of combination of the different amino acids. By this method deformations and deviations of the structure of proteins in the serum may be determined in cases of illnesses such as cancer and tuberculosis.

Wednesday, the last day of the symposium, provided a complete day's lecture programme. The Industrial Advances Section began with Mr. G. W. C. Milner from the Atomic Energy Research Establishment, Harwell, reviewing 'Recent Advances in the Analytical Chemistry of Non-Ferrous Metals'.²⁵ The application of EDTA to the volumetric determination of metals, which previously had been determined gravimetrically, the action of EDTA in these titrations, and methods for detecting end-points,



Dr. A. J. Nutten (Birmingham University, secretary in charge of visits and social functions) greets Dr. Gottfried Beck (Switzerland)

were all discussed. Applications of this technique in the analysis of alloys for Th, Al, Zr, Ga, Bi, Ni and Zn, were given in detail. Recent developments in the analytical chemistry of Nb and Ta were also outlined.

Oscillographic Analysis

Professor J. Heyrovsky of the University of Prague was unable to be present, and his paper on 'Advances in Oscillographic Analysis with the Polaroscope' was read by Mr. J. E. B. Randles of the Physical Chemistry Department, the University of Birmingham. Analysis by means of oscillographic polarography with ac was discussed and illustrated by luminous diagrams. Practical examples were given in oscillographic analysis of various sulphonamides, local anaesthetics, purine derivatives, alkaloids, pyridine carboxylic acids, vitamins, antibiotics, hormones, etc. The differences between diagrams obtained with the dropping and streaming mercury electrodes were pointed out, and the formation of 'artefacts' explained in the case of acetylene, which can be determined oscillographically, although it is polarographically inactive.

The last lecture in this session was given by Mr. G. H. Osborn on 'Recent Advances in the Use of Ion-Exchangers in Analysis.' A brief review of the latest types of ion-exchange materials available was given, followed by a comprehensive description of recent developments in analytical methods employing these materials. These were classified as follows: mixed-bed techniques; cation exchangers; anion exchangers; separation of ionised and unionised substances; dissociation of insoluble substances; selective elutions; amphoteric separations; ion-exchange chromatography (frontal, elution, and displacement); ion-exclusion; chelating resins; ion-exchange membranes; and ionophoresis. A critical estimation was given of these techniques. Methods of regeneration of the resins, especially of mixed-bed types, were considered in addition.

In Session 2, Dr. J. Sheridan of the Physical Chemistry Department, University of Birmingham, gave an account of 'Chemical Analysis by Microwave Spectroscopy.' He reviewed briefly the techniques of microwave spectroscopy and illustrated its extreme resolving power and the sensitivity of the results to molecular shape. Its applications to chemical and isotopic analysis were discussed, and certain limitations and experi-

mental difficulties outlined. In special cases, where small differences between dipolar molecules must be detected, the method promises to be a valuable supplement to established analytical methods.

This section was brought to a close by Dr. W. N. Aldridge of the Medical Research Council, who outlined 'Recent Advances in Absorptiometry.' In the inorganic field, the work of McCurdy and Smith on the determination of iron and copper using 1,10-phenanthrolines was discussed, and a review of the various modifications of the thiocyanate method for niobium given. Methods depending on the catalytic activities of metals had much to offer when high sensitivity was required, such as the ultra-micro determination of manganese, silver, and copper. In the organic field, the phenyl azide method for aldrin was mentioned, and the Watts and Crisp method for the determination of maleic hydrazide and isonicotinic hydrazide was described. Among the improvements to existing procedures, two methods were chosen, these being the use of chromatographic techniques in conjunction with the 2,4-dinitrophenylhydrazine method for keto-acids, and the use of cyanide in the nitroprusside reaction for sulphhydryl groups.

Analytical Reagents

The final lectures in the Original Investigations Session commenced with Dr. A. Sykes of the Organic Chemistry Department, University of Birmingham, speaking on 'The Effect of the $-CF_3$ Group on the Properties of some Analytical Reagents'.²⁶ A brief outline of the preparation of some trifluoromethyl substituted benzimidazoles and 8-hydroxyquinolines was given. The trifluoromethylbenzimidazoles were studied as possible precipitants for metallic ions. The trifluoromethyl group was also shown to have a pronounced effect on the lability of the hydrogen atom of the imine group. As a result of this it was possible to titrate some of the derivatives with standard sodium hydroxide solution in the presence of phenolphthalein as indicator. The trifluoromethyl substituted 8-hydroxyquinolines had also been examined as precipitants for metallic ions. Several interesting properties were described and an attempt made to correlate the structure of the reagents with their observed behaviour in the light of existing theories on the structure and stability of organic reagents.

Dr. Sykes' lecture was followed by Mr. F. Holmes from the University College of North Wales, Bangor, who discussed 'The Volumetric Determination of Small Quantities of some Metallic Ions using Organic Complexing Agents.' Attempts had been made to convert the standard gravimetric procedures with anthranilic acid, quinaldic acid, and quinoline-8-carboxylic acid into volumetric methods, using cerate oxidation of the centrifuged metal complex and back-titration of the excess cerate with oxalate. Although the method works well for anthranilic acid, it was not successful in the case of the other two reagents.

After lunch, Dr. R. J. P. Williams from Oxford University lectured on 'The Nature of Metal-Ion/Reagent Complexes with Special Reference to their Spectra.' The theory of the absorption spectra of such complexes was discussed and illustrated by reference to the ferrous and cuprous phenanthrolines, and to the ferric/phenanthroline complexes. The choice of organic reagents for colorimetric methods was mentioned briefly. Dr. C. L. Wilson, Reader in Analytical Chemistry at the University of Belfast, continued the session with a short paper on 'Investigations on Organo-Metallic Complexes.' This work had been an attempt by means of infra-red and magnetic susceptibility measurements to elucidate the constitution of the metallic complexes of anthranilic acid, but the results were as yet inconclusive.

3-Methoxybenzidine as Indicator

The final lecture in Session 3 was delivered by Mr. M. Kapel, a member of the University of Birmingham Analytical School. He outlined 'The Indicator Properties of 3-Methoxybenzidine.' This compound had been examined because of its structural similarity to *o*-dianisidine, a compound which has found wide application as a redox indicator. The preparation of 3-methoxybenzidine was described briefly, and its indicator properties detailed, especially in respect of the zinc/ferrocyanide titration in which it finds its best application.

During the course of the Wednesday morning, Dr. G. F. Hodsman from Oertling Ltd. gave the fourth and last of the plenary lectures, entitled 'The Development of Precision Weighing—An Historical Survey.' The survey was from the earliest process, that of 'hefting' or comparison of weights by lifting them in the hands; and then on



Mr. K. Gardiner (Pest Control Ltd., Cambridge) and Dr. K. Kaarik (Sweden)

to the first balance, which was probably of Egyptian origin. The first major advance in balance design was the introduction of the 'through arm pivot,' which obviated arm length troubles, about 1500 BC; the second major advance, in the sixteenth century, was the introduction of the knife edge. The first known balance manufacturer, Robinson of London, about the early nineteenth century, the Kuhlmann balance in 1906, and three further important advances in 1939 (the use of projection-reading, the fitting of air damping, and the use of automatic weight lifters) brought the speaker to the present day sub-micro quartz fibre torsion balance.

The exhibitions held in conjunction with the symposium proceedings were divided into three categories:

I—A Display of Historical Scientific Literature. This exhibition of early scientific books and original papers was drawn from material owned by the University Library. Examples were shown which illustrated the history of chemistry and its development into a discrete modern science. Included in the exhibition was a collection of rare herbals.

II—A Trade Exhibition of New Scientific Equipment with Special Reference to Applications in Analytical Chemistry.

III—Demonstrations of New Techniques in Analytical Chemistry. This consisted of a display of new techniques and apparatus which had been developed by various firms, persons, and research associations.

The three outstanding events among the

social functions were the reception of all delegates by the President of the Symposium, Professor Melville, at the Guild of Undergraduates Union, the civic reception of all delegates by His Worshipful, the Lord Mayor of Birmingham, at the Council House, and the symposium dinner, held in the Guild of Undergraduates Union. Throughout the entire symposium small groups of delegates were entertained at a series of lunches and dinners at the Undergraduates Union.

The local industries provided a series of very interesting visits to their establishments, so giving the delegates an insight into the applied side of chemistry in Birmingham, and at the same time displayed lavish hospitality in the form of lunches, dinners, visits, coach tours, and a trip to the Stratford Memorial Theatre. On the Sunday, all-day coach tours were provided to local beauty spots. A programme of daily visits and coach tours was arranged specially for lady visitors accompanying delegates to the symposium, and this enabled them to enjoy the meeting as much as the delegates themselves. It was agreed by all concerned that the hospitality had never before reached so high a standard in this country.

The symposium was brought to an official closure late on the Wednesday afternoon with some remarks by Mr. J. R. Leech, J.P., Chairman of the Society, in the Main Chemistry Lecture Theatre. He expressed the thanks of the Symposium and General Committees of the MSAC to the authorities of the University of Birmingham for permission to hold the symposium in the university buildings, and to the directors of the various firms for their generosity in providing entertainment in the form of the social functions, and in permitting delegates to visit their works and laboratories.

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IN THE EDITOR'S POST

Marsden's Solvents Manual

SIR,—It was most valuable of your reviewer to discover the unfortunate discrepancy between the data in Mr. Marsden's chart, and our description on the jacket of 'Solvents Manual' by C. M. Marsden (THE CHEMICAL AGE, 1954, **71**, 676). What happened was that in the course of production of this very intricate piece of work, the author decided with regret, that a whole group of substances would have to be omitted to achieve legibility. Unfortunately our jacket description had by then got into print, and such things, as you will know, have a horrible vitality. We are grateful to your reviewer for pointing out the error.

Yours faithfully,

P. J. EDMONDS.

Managing Editor,
Cleaver-Hume Press Ltd.

I.C.I. Install New Press

A 450-ton universal hydraulic press has been installed recently by the Metals Division of I.C.I. at Kynoch Works, Witton, Birmingham 6. It is a modern four column upstroke press, actuated by an air hydraulic accumulator system at a pressure of 4,300 psi.

Its installation has enabled the Division to offer additional facilities for heavy fabrication and flangework, and these are described in an illustrated booklet which has just been issued.

The type of work that can be undertaken ranges from the forming of dished segments, shallow dishes and other pressings to the joggling of heavy sections and the production of irregular and other bends difficult to accommodate on any other type of forming press. Other work includes blanking of plate material and flattening of distorted components.

Labour Turnover : A Current Problem

by JOYCE R. LONG, B.Com., Ph.D.

A HIGH rate of industrial labour turnover can be a serious problem since the replacement of workers who leave involves firms in several additional costs. There is the cost, first, of finding and engaging a replacement. Secondly, if a suitable new worker is not available immediately there is an increase in overhead costs per unit of production (because of factory space, machines and office and managerial staff not being fully occupied). A temporary shortage of workers may also disorganise the steady flow of production between departments.

Lastly, when a suitable replacement is found costs are incurred by the firm during the training period. For instance, special instructors or other experienced workers have to spend time teaching the new worker; machinery is not, at first, utilised to full capacity and may require more maintenance than when operated by experienced workers; the presence of new workers may lead to a rise in the accident rate; and the wage paid to a new employee probably exceeds the value of the product for at least part of the training period.

Incidentally, a constant 'change-round' of workers means that national as well as private resources are wasted. Manpower is wasted since new workers produce less and need more supervision than experienced ones and raw materials, machinery and factory space are not used to the best advantage when inexperienced workers are employed.

Labour Turnover Defined

Labour turnover is defined here as the number of workers leaving each year (either on their own account or because they have been discharged) and having to be replaced, expressed as a percentage of the average number of workers in employment. Redundant workers are, therefore, excluded.

A certain amount of labour turnover is desirable since it allows industry to adapt itself to changing circumstances. When there is a little unemployment workers must leave inefficient firms and declining industries if other firms and industries are to expand. It may be argued, also, that firms tend to stagnate if there is no interchange of

workers between themselves and other firms. There is also a certain amount of unavoidable labour turnover as, for instance, when women leave to get married or when older workers retire. Since the war the rate of labour turnover in this country has, however, far exceeded that which is necessary for these purposes.

The Factor of Unemployment

There is one important influence on the level of turnover which is outside the individual firm's control—the amount of unemployment. It was shown many years ago¹ that labour turnover is much lower when trade is depressed than when it is prosperous, and a more recent inquiry by the present writer at Birmingham University² has confirmed this conclusion. In one firm, for instance, the rate of turnover in 1931 was only half that in 1933, when trade had improved, and only two-fifths of that in 1936-7. American statistics show that there is the same relationship between labour turnover and unemployment in the United States.

This close relationship between unemployment and labour turnover does not mean, however, that when there is full employment a firm must accept a high level of turnover as inevitable for some kinds of workers, and some kinds of factories have relatively low turnover rates even when trade is booming.

Men usually have lower turnover rates than women. In the firms studied during the Birmingham inquiry mentioned above the rate of female turnover in 1949 was 61 per cent as compared with only 31 per cent for the males. This may suggest that a firm's turnover rate may be reduced if some of its women workers are replaced by men. The situation is not, however, quite as simple as this. Married women are often responsible for the high turnover of their sex; single women who live locally often have a lower turnover than the men in the same factory.

The type of work also enters into it. Women usually do unskilled and semi-skilled work and the Birmingham inquiry showed that their turnover is usually less than that of the unskilled men in the same factory and sometimes less than that of the semi-skilled

men. The replacement of women by unskilled or semi-skilled men may, therefore, lead to a rise in turnover.

Workers with permanent homes near their employment have much lower rates of turnover than immigrants from other areas. Many of the firms covered by the Birmingham inquiry had gone to considerable expense to persuade Irish and Scots women to work in their Midland factories but this proved to be a costly source of labour for after short periods of employment many of the immigrants either returned home or moved to other Midland firms. In one firm, for instance, both the Irish and Scots women had turnover rates of about 150 per cent in 1949 as compared with only 33 per cent for local full-time women. In other parts of the country, too, firms are likely to find that the wastage among transferred workers is high, particularly if there are many firms competing for labour in the same area.

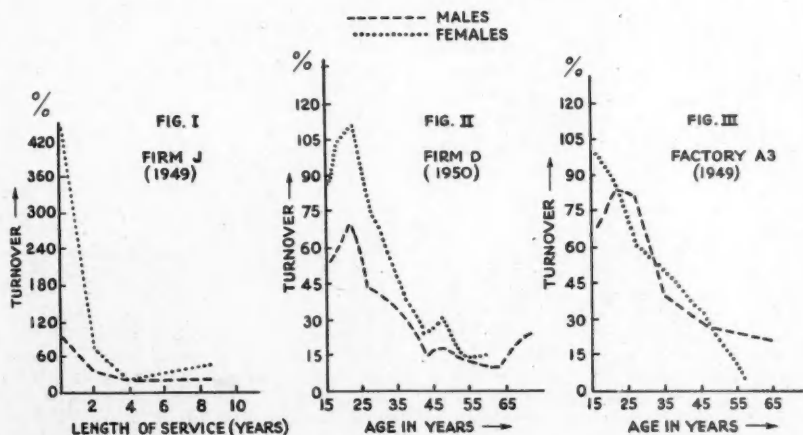
The turnover of local workers seems to depend on the particular districts in which their homes are situated. It is to be expected, for instance, that workers living where there are many alternative jobs will have higher rates of turnover than workers in other districts, but the extent of the difference is remarkable. In one firm, for instance, the comparable figures in 1948 were 35 per cent and 14 per cent for men and 58 per cent and 28 per cent for women. (Traveling times were the same for both groups of workers).

It might be thought that people living near their work would have comparatively low turnover rates but it has been found that turnover does not increase regularly with travelling time; workers who have to spend half an hour or more in getting to work tend to have higher turnover rates than other workers, but the difference is small.

It is well known^{2,4} that long service workers have lower turnover rates than newcomers, but the extent of the difference is not always appreciated. Fig. 1 shows the situation in one firm and in other firms it is similar, although the exact shape of the curve varies. Turnover is highest during the first month of service and is much higher during the first six months of service than during the second six months.

Workers above the age of 25 to 30 tend to have lower turnover rates than other workers. Figs. II and III show how turnover declined beyond this age group in two firms. There is a similar relationship between turnover and age in other firms. The influence of age and length of service are interconnected since the older workers in a firm tend also to be the longer service employees, and vice versa. Age appears, however, to have an independent influence, for in several factories workers over 30 years of age were found to have higher turnover rates than younger workers with the same length of service⁵.

Factories which are the main employers in isolated areas are at the greatest advantage,



while factories situated alongside others with the same products tend to have high turnover rates, for then all grades of workers can move without loss of skill. This high mobility of labour must be offset against the advantages which such localised centres have to offer. Employment opportunities in the development areas are, on the whole, less plentiful and varied than elsewhere and turnover therefore tends to be lower there than in many other parts of the country.

It is uncertain how the size of firm or factory influences the rate of turnover. Welfare arrangements tend to be more highly developed in large firms than in small ones and a large firm can offer a wider choice of jobs and of workmates than a smaller one. On the other hand workers in large firms may feel themselves to be only cogs in a machine. As has been said¹ 'when there is a board of directors . . . issuing paper orders that gradually percolate through a regular hierarchy of officials of various ranks from general manager to foreman, before they reach the man actually on the job, it is not an easy situation for human nature to stand.'

The close personal relationships in a small firm and the employee's appreciation of the importance of their individual outputs may result in the workers there identifying themselves more closely than elsewhere with their firm. Thus the issue to be decided is whether the worker's attitude to his work is influenced more favourably by elaborate provisions for his welfare and a varied choice of employment or by being a member of a small and socially compact group.

Results Contradictory

We do not yet know how turnover varies with the size of firm but we have information about turnover in factories of different sizes. The results are, however, inconclusive since data published by the British Institute of Management show that factories with more than 1,000 employees had the lowest turnover rates while the results of the Birmingham inquiry suggest that high turnover rates tend to be more common among larger factories.

Factories providing a good deal of skilled employment tend to have lower turnover rates than others. In one firm, for instance, the skilled man's turnover was 6 per cent, that of the semi-skilled was 26 per cent, and the unskilled turnover was 65 per cent. Skilled workers are usually relatively stable even when there are other jobs in the same

district to which they can move without loss of skill.

The high turnover of unskilled workers cannot be ascribed solely, therefore, to their being able to move from one firm to another without financial loss and it is probable that it is due, at least to some extent, to their attitude towards their work being different from that of more highly skilled workers. This difference of attitude is also demonstrated by the fact that unskilled workers are more subject to voluntary absenteeism than skilled workers².

High Wages: Low Turnover

Factories paying relatively high wages tend to have low turnover rates. A man usually judges the adequacy, or otherwise, of his wage, not by absolute standards, but by comparing it with what he can get elsewhere; since few workers are willing to move to another part of the country it is the earnings of other workers in the same area which are the principal determinant of whether a firm is paying sufficiently high wages to retain its workers. Earnings sufficient to retain employees in, say, Scotland or South Wales would probably be totally inadequate in London, Birmingham or Coventry.

It seems that even quite small differences in earnings can have a marked effect on turnover. In one firm, for example, the general labourers (in 1948) earned between £5 and £5 10s. per week and had, as elsewhere a high rate of turnover, but other labourers who were allotted special tasks had a low rate of turnover, although they earned only 10s. or so more each week than the general labourer. This may have been due to the more conscientious and reliable workers being selected for these special tasks, but the small extra earnings are probably important.

It is, however, probably unnecessary to dwell any further on the influence of earnings. There is a strong temptation to believe that a factory's ability to retain its workers depends almost entirely on the contents of their weekly wage packets; but considerable variations in turnover have been encountered between factories employing similar types of labour and having similar wage structures. Sometimes, too, turnover in a given occupation is higher where the workers have the higher earnings. Thus, although wages are important, other influences are sometimes even more powerful.

Good physical working conditions are an

aid to low turnover rates. High turnover rates were encountered in a number of foundries. Women employed on 'sorting' and 'wrapping' had lower turnover rates than those on machines in the same factories where it was dirty and noisy. But the influence of working conditions appears to be relatively weak and often hidden by that of other factors. They, therefore, do not guarantee low turnover rates and turnover may be extremely low even where, to an outsider, the work appears hard and most unpleasant.

Factories in which there are good personal relationships tend to have low turnover rates. Many investigators (notably Professor Elton Mayo and his associates in America) have shown that the relationship between management and workers and between the workers themselves plays a large part in determining the attitude of employees to their work, and indirectly, has a marked effect upon productivity, labour turnover and absenteeism. The results of the Birmingham investigation confirmed this conclusion and suggested moreover, that, within certain limits, harmonious personal relationships are more important than good working conditions and high weekly earnings in ensuring a contented labour force.

This discussion of the factors influencing labour turnover suggests various measures which firms may adopt. It suggests, for instance, that firms should be as discriminating as possible in their selection of new workers—engaging, for example, single rather than married women and 'local' workers rather than immigrants from other areas. Since workers are most liable to leave during their first months of employment, new workers should be placed in as suitable jobs as possible and helped to become accustomed to their new social environment.

Where labour costs are an important item, even a change of location to an area where there is less keen competition for labour may be worthwhile. The skill demanded by a factory's type of production is to a large extent fixed but this discussion suggests that the break-down of jobs in mass-production techniques has certain disadvantages. The cost of labour turnover may be sufficiently great to make some increase in wages worthwhile. Lastly, an improvement in the personal relationships in a factory is likely to increase labour stability.

It should be remembered, of course, that

these measures involve questions other than labour turnover and it may be decided that, on balance, they would not be advantageous. For instance, a change in the location of production which would reduce labour turnover might so increase the cost of transporting raw materials and finished products that the net effect of the change was to increase production costs. Here we are only considering effects on labour turnover.

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Selling 'Savlon'

IMPERIAL Chemical (Pharmaceuticals) is launching its first large-scale advertising campaign on entering the retail market with a new antiseptic cream called 'Savlon.'

The active ingredient in 'Savlon' is the quaternary ammonium compound Cetavlon, which, since its introduction by I.C.I. over 10 years ago, has become firmly established in hospitals and among doctors as a bactericide and detergent. It is used for the first aid treatment of minor wounds and injuries, burns, scalds, skin disorders and so on.

'Savlon' antiseptic cream will serve the same purposes in the home. It is effective against a wide range of germs, and is absolutely safe and non-irritant, even when applied to the most sensitive skin.

Dieldrin On Trial

DIELDRIN, the insecticide made by Shell, is being tried out in a malaria control campaign in Northern Luzon, at the northernmost tip of the Philippines. Reporting this, the *WHO Newsletter* says that it is said to be more potent against insects than DDT.

The trials of Dieldrin were planned with the help of a World Health Organisation expert. One of the objectives of the experiment is to determine whether a single spraying with a dosage of 50 milligrams per sq. ft. would be enough to protect the population from malaria for two years instead of one.

Unusual Exchange Resin Marked Mercaptan Selectivity

A RECENT paper (H. T. Miles, E. R. Sadtman and W. W. Kielley, *J. Amer. Chem. Soc.*, 1954, **76**, 4041) describes the preparation of a new ion exchange resin with unusual properties. The resin is prepared by the mercuration of an alcohol-soluble phenol-formaldehyde resin with mercuric acetate in ethanol solution, the resulting polymer being precipitated as a yellow powder containing about 35 per cent of mercury. The new resin has the property of selectively removing mercaptans from aqueous solution, the mercaptans being readily eluted by a solution of 2-mercapto-ethanol or hydrogen sulphide.

As an example, glutathione and cysteine are quantitatively retained in amounts of 13 and 20 mg. respectively upon a column 12 mm. in diameter and 80 mm. long consisting of a mixture of 2 g. of Celite and 1 g. of mercurated resin. These compounds are eluted, although not completely, by an aqueous solution of 2-mercapto-ethanol.

Co-enzyme A Retained

Oxidised glutathione is not retained upon the column at pH 7.0, but if the pH is lowered to 3.0-3.5, partial retention is observed. It is postulated that this partial retention is due to reduction of part of the oxidised glutathione by the resin, and this view is supported by the fact that aqueous extracts of the resin reduce equivalent amounts of iodine and oxidised glutathione.

Co-enzyme A is retained by the resin but cannot be eluted with 2-mercapto-ethanol or with acid solutions of hydrogen sulphide. It may be eluted at pH 7.7 however with a 0.1 M aqueous solution of potassium sulphide. The selectivity of the resin is demonstrated by the observation that of a range of water-soluble amino acids only those containing a mercapto group are retained upon the column.

There are many possible applications for a resin with this unusual selectivity and it should prove extremely valuable in the examination of biological fluids, the more so since many naturally occurring mercaptans such as co-enzyme A have great biological significance. Further, since the

degree of retention upon the column appears to vary with the pH of the solution and the rate of elution with the nature of the eluate there is a strong possibility that a column of mercurated resin may be used to separate mercaptans chromatographically.

Another field in which this new type of resin may have an application is that of the analysis of the sulphur content of petroleum fractions, where rapid and reliable procedures are lacking at present. A further promising line of research would be the investigation of the introduction of mercury atoms into other types of resin such as polystyrene.—J.R.M.

Anti-Corrosion Methods

A STUDY of anti-corrosion methods has been carried out by European experts at meetings organised by the OEEC during the 27th International Congress of Industrial Chemistry recently held in Brussels.

These meetings, which were presided over by M. Roger de Smet, Director of the Belgian Chemical Union, brought together European executives who had taken part in a study mission to the United States, arranged under the OEEC Technical Assistance Programme, during the summer of 1953. Together with a number of specialists on corrosion problems, they were thus provided an opportunity for studying the various technical and economic aspects of this phenomenon, whose importance is often under-estimated in Europe. In the United States, annual losses from corrosion are estimated at between \$5,500,000,000 and \$6,000,000,000 and involve the destruction of more than 2 per cent of total steel tonnage.

The experts discussed the report 'Corrosion Problems and Prevention in the Chemical and Petro-chemical Industries in the United States' (see *THE CHEMICAL AGE*, 1954, **71**, 781) and studied its conclusions on protection techniques and anti-corrosion materials. They were unanimously in favour of the report's recommendation that a European association which would group all corrosion specialists and would become a centre for exchange of information should be set up as speedily as possible.

New US Titanium Plant

Production of 7,000 Tons a Year

PLANS for production of at least 7,500 tons of titanium metal a year at a new plant costing approximately \$31,500,000, have been announced by A. L. Foscoe, President of Electro Metallurgical Company, a Division of Union Carbide and Carbon Corporation, following the signing of a contract with the Government. Under the terms of the contract, the General Services Administration has agreed to buy from Union Carbide, for a five-year period at prevailing market prices, what is not sold to private industry.

This will be the first commercial production of titanium by a method other than the Kroll process. The Electromet process involves sodium reduction of titanium tetrachloride, which produces metal of exceptional quality. The company has had this process in operation on a pilot and prototype plant scale at its Metals Research Laboratories in Niagara Falls, New York. The commercial plant, which is expected to take about a year and a half to get into production, will be built at Ashtabula, Ohio. Electromet also has at Ashtabula a plant for the production of ferro-alloys and calcium carbide.

The new titanium process has been the subject of research and development for the past five years at a cost of almost \$2,000,000. Actually, Electromet has been conducting research on various methods for the production of titanium for almost 15 years, and has been regularly producing alloys of titanium for over 20 years.

While the primary market for titanium metal at the present time is in jet planes and other aircraft application, the chemical and petroleum industries also offer sizeable potential markets.

Electrolytic Cobalt

AS a result of improvements in refining techniques, The International Nickel Company of Canada Ltd. has initiated production of electrolytic cobalt at its Port Colborne refinery. This marks the first commercial production of electrolytic cobalt in Canada.

Hitherto, Inco's entire cobalt output has

been marketed as oxides and salts produced at its Clydach, Wales, refinery. Through its new process the company makes available a high purity cobalt which is a companion to its electrolytic nickel. This electrolytic cobalt will be particularly valuable in the manufacture of alloys where high purity is advantageous.

Inco's electrolytic process for the production of cobalt was developed after extensive research and pilot plant studies by the company. Cobalt is one of 13 elements recovered from the company's Sudbury District, Ontario, ores. Nickel is the principal product. The others are copper, platinum, palladium, ruthenium, iridium, rhodium, gold, silver, selenium and tellurium. In addition, Inco furnishes high quality smelter gas for conversion into liquid sulphur dioxide and normal smelter gas for sulphuric acid production. Soon iron will be recovered as premium grade iron ore.

French Buy British

IN Paris household refuse is collected and sent daily to plants which use it as boiler fuel, being first partially dried and then burned in specially designed furnaces. However, these suffer considerably from scale deposits, and the boilers have to be shut down approximately once a week to be swept and scaled by hand.

In order to maintain the boilers in operation for longer periods, a test was recently carried out at one of the refuse burning plants with Firescale and Soot Eradicator, one of the products of Xzit (G.B.) Ltd. The test was made on the boiler which suffered most from slag accumulation. The boiler tubes were swept but not scaled before the treatment began and, after six days, were covered with a very fine dust which fell down on its own. In a number of places the tubes were completely clean. The old deposits which had not been removed before the test were more brittle and did not adhere so strongly to the tubes. They were removed by sweeping.

During the second part of the treatment the boiler was kept in operation for two weeks without being shut down. As a result of this test, Firescale and Soot Eradicator is now being used by both the Issy and Ivry plants in Paris.

Oil-Based Paints

BSI Issue 12 New Standards

THE British Standards Institution has just issued twelve new standards for oil-based paints. Following their issue, these standards have been withdrawn:—BS. 261-2, 293-5, and 371 (Ready mixed paints [oil gloss]); BS. 929 (Ready mixed oil paints); and 1011 (Red lead ready mixed paints).

The new standards, BS. 2521-5, for priming paints include one lead base primer for woodwork, one leadless grey primer for interior use, three lead base primers for iron and steel and one red oxide primer for iron and steel. These priming paints are designed for use under undercoating and finishing paints complying with BS. 2525-32, but can also be used under conventional hard gloss paints, provided appropriate drying times are allowed before the application of the undercoatings.

Straight Linseed Oil Paints

BS. 2525-32 covers undercoating and finishing paints of the types known as 'straight linseed oil paints.' These British Standards do not apply to those types of paint known under such titles as hard gloss paint, enamel paint, etc., and the paints manufactured to these standards will not have the brushing properties or the finish and gloss of such types of paint. The paints are designed for the protection of exterior surfaces, and are not recommended for interior decoration.

BS. 2525 gives two basic compositions which between them cover twelve colours of undercoating paints. A table is included indicating which of these undercoats is appropriate for each of 91 colours given in BS. 381C to which the finishing coats in BS. 2526-32 may be made.

Requirements are stated, as appropriate for composition, consistency, drying time, water content and keeping properties and for colour, finish and opacity. Appendices describe sampling technique and give methods of test.

Among the Government departments and other organisations represented on the committee responsible for the production of these standards were: Board of Trade; DSIR; Building Research Station; National Paint Federation; Society of British Paint Manufacturers Ltd.; Paint Manufacturers and Allied Trades Associations; Federation

of Painting Contractors; Institution of Municipal Engineers.

BS. 2521-4 and 2525-32 may be obtained from the Sales Branch, British Standards Institution, 2 Park Street, London, W.1, at 3s. and 6s. respectively.

Fertiliser Productivity

ISSUED by the Foreign Operations Administration, and distributed by the British Institute of Management (pp. 68, 5s.) is the latest case study data on productivity and factory performance, entitled 'Fertiliser.'

This report is intended primarily for the use of European production managers, superintendents, and methods engineers who are concerned with productivity problems, and a study of the technical sections should make it possible for these plant officials to compare manufacturing conditions in their plants with the operations in the plants surveyed in the report.

In addition, the general discussion of productivity and the enumeration of man-hours per unit in the manufacture of fertilisers should be of interest to all government, labour and trade association officials.

The products covered in the report were selected on the basis of requests made by European industry; the plants selected for case studies are intended to provide examples of the manufacture of these products in American plants, but do not represent a statistical sample of American industry.

The case studies are not meant to be a substitute for the visits of industry teams, or to give novel technical information, but are designed to provide managements with a yardstick by which they can compare their performance with that of US plants in a similar industry.

Research Exhibition in Manchester

An exhibition 'Technical Information and Research' now open at the Manchester Central Library focuses attention on some of the means by which firms, chiefly the smaller ones, can obtain technical information and keep in touch with the progress of research. The British Rayon Research Association, the British Hat and Allied Feltmakers Research Association, the Department of Scientific and Industrial Research and the Manchester public libraries are taking part.

Novel Glass-Drawing Methods



AN electronic tube-drawing tower 130 ft. high for production of clinical thermometer tubing has been erected at the Whitefriars glassworks of James Powell & Sons Ltd., Wealdstone. Only structure of its kind in the country, the tower was the conception of Mr. W. J. Wilson, Whitefriars' managing director, and Mr. C. H. Cooper, technical director.

Height and speed of the draw are controlled by electronic equipment and motors housed at the base of the tower, which is lit for night-climbing and fitted with safety-ladders.

The tower is equipped with four drawing trolleys which, by means of wires, hoist the molten glass from the four billets anchored at the foot of the tower. When a trolley has drawn the thermometer tubing to the required height, the operator, by means of electronic controls, regulates the trolley's drop in stages so that the tubing can be cut into canes of convenient length.

The new tower has improved the quality of the clinical thermometer tubing produced, and waste has been eliminated. Clinical thermometer tubing—a valuable British export—was formerly produced at Whitefriars by means of the horizontal hand-drawn method. The tower was constructed by Pirelli General Ltd. of Southampton.

Tall Oil Contest

THE Tall Oil Association has established a contest to recognise outstanding unpublished papers and research work of persons working on tall oil and tall oil products. The three best papers will be given awards of \$500, \$250 and \$100 respectively.

Dr. Arthur Pollak, technical consultant for the association and chairman of the Judging Committee explained that 'these papers will be judged on their originality and technical merit, not on their value as literature.' The closing date is 1 September, 1955.

Entry blanks may be obtained by writing to Awards Committee, Tall Oil Association, 122 East 42nd Street, New York 17, New York.



The Chemist's Bookshelf

INTRODUCTION TO THE CHEMISTRY OF ENZYMES. By Keith J. Laidler. McGraw-Hill Publishing Co., London. 1954. Pp. 208. 36s.

The most important feature of this book, and one for which all students will be grateful, is the attempt the author has made to supplement his account of what enzymes do, by a brave effort to tell how they do it. This approach is not accomplished simply by the insertion of a single speculative chapter, but is present as a dominant structural element throughout the book. It has the immediate effect of making the author's theoretical chapters take on a new garb of practical significance often lacking in other accounts of this subject.

Enzyme-substrate complexes, or K_m values, to mention only two student stumbling-blocks, usually left wandering in an all-too-theoretical world of paper logic, here achieve some interpretation in mechanism which aid their imaginative release and justification. This is not an easy task, for however wary the author, the present inadequate knowledge of enzyme mechanisms inevitably forces him to use such terms as 'activated state' which carry a vagueness with them that only much further experimenting will dispel; yet so far as a lucid account of enzyme mechanism can be given today, it has been admirably done in Dr. Laidler's book.

In its general scope the book deals adequately with the various types of enzyme action—the hydrolases and phosphorylases; the oxidising enzymes; the isomerases and transferases—and it might be argued with some truth that its monograph form permits a consistency and imaginativeness of treatment rarely observed in enzyme sections of general text-books. It has been written particularly for biochemistry students: it can be thoroughly recommended to them—and to their teachers.

Dr. Laidler seems to have had inordinate trouble with the formula of fructose—

it stalks through his pages in false guise, while ribose occasionally takes it into its head to join the sugary fun-and-games; but these, and a few other indiscretions, are minor matters and may readily be set right. They in no way diminish the very real virtues of this book.—F. H. MALPRESS.

THE STORY OF SPICES. By J. W. Parry. Chemical Publishing Co. Inc., New York. 1953. Pp. 208. \$4.50.

This is one of those books which can only be termed 'light reading.' It contains no chemistry and nothing of especial interest to the chemist. On the other hand it is the sort of book with which almost anyone can completely relax for a few hours. From such gems as 'The Holy Bible,' the 'Medical Papyrus of Thebes,' 'The History of Herodotus,' Pliny's 'Natural History,' Dioscorides's '*Materia Medica*,' 'The Travels of Marco Polo,' 'The Decameron,' 'The Canterbury Tales,' 'The Thousand and One Nights' as well as the most reliable history and reference books, Mr. Parry has culled much interesting material concerning the history of some 40 'aromatic and pungent products.' The cultivation, uses for and trade in these products is traced from roughly 4,500 B.C. up to the present time, and the author shows how the search for spices led to the discovery of new continents. An epilogue gives a brief outline of the development, present standing and future trends of the spice industry and an appendix gives a brief description of the origin and character of the spice plants.

As we have said there is nothing much in this book to appeal to the chemist as such. That is not to say, however, that the book does not contain information of scientific interest. What searcher after truth, for instance, would not be interested to learn that 'parsley was believed capable of warding off intoxication and, for this reason, it was woven into wreaths and worn by Greeks

and Romans at their banquets.' And what modern scientist could fail to be impressed by the accuracy of Pliny's conclusions that 'garlic has very powerful properties . . . the very smell of it drives away serpents and scorpions.'—R.C.H.A.

TECHNIQUE OF ORGANIC CHEMISTRY, Vol. VIII: INVESTIGATION OF RATES AND MECHANISMS OF REACTIONS. Edited by S. L. Friess and A. Weissberger. Interscience Publishers, New York and London. 1953. Pp. xxiii + 760. \$13.50.

Most chemists are by now well acquainted with 'Weissberger,' and the mere fact that casual reference to the work in this fashion has become common is in itself an indication of the extreme value of the series. The first two volumes of the series are undoubtedly the best known and most used, and the more specialised volumes which have subsequently been added have a more limited but none the less important currency.

The present volume comes fully up to standard. Its appeal will not be wide at present, but the growing interest in the mechanisms of organic reactions is bound to make it a valuable and increasingly used member of the series. The topics dealt with are rate processes and their investigation, homogeneous gas phase reactions, reactions in the liquid phase, homogeneous catalysis, polymerisation, biological reactions, and rapid reactions. The names of the 15 contributors leave no doubt as to the reliability to be expected of the contents.

The treatment is advanced, but the determined reader will find it clear. Nor will he progress far before he realises how little really rigorous treatment of organic reactions is possible in our present state of knowledge, and how much we depend on approximations, deductions from experiment and—dare it be said—inspired guesses. That this should early be made clear is most desirable, both because it is only thus that the topic can be properly related to chemistry as a whole, and because it will thereby be emphasised how much remains for investigation. The critical reader will learn to realise the pitfalls that lie in wait for those who attempt, for example, without due regard for experiment, to theorise about even the simplest organic industrial processes; and in consequence the book should make salutary reading even for chemists whose direct and immediate interest does not lie in this field.

A brief cumulative index is given for

Volumes I-VIII of the series. Perhaps this is a little premature, in view of the fact that Volumes VI and VII have not yet appeared, but it will probably prove of some service for ease of rapid reference to the volumes actually in existence. The production is uniform with that of earlier members of the series, and is consequently of a high standard. Possessors of the earlier volumes should have no hesitation in adding this to their shelves.—CECIL L. WILSON.

QUANTUM MECHANICS. By F. Mandl. Butterworths Scientific Publications, London; Academic Press Inc., New York. Pp. viii + 233. 35s.

There are now a number of good books on quantum mechanics but a well written new work is always welcome. The present volume is based on a course of lectures by Dr. Mandl delivered at AERE, Harwell, during 1952. It is primarily designed for experimental physicists but the approach is that of a mathematician and the treatment is rather formal. Starting from first principles it develops the general theory in a satisfactory manner and gives an account of some of the more important techniques (including matrices). Applications to collision processes and to a few other specific problems are outlined but the author's main concern is rather with the discussion of the basic concepts of the subject. He does not for example describe the variational method. In the reviewer's opinion the book, though excellent in many ways, is likely to be of little value to most chemists. University teachers should find the examples given at the end of each chapter useful.

The printing and production is praiseworthy.—D.R.B.

HISTOCHEMISCHE METHODEN. A Collection by Walther Lipp. Part 3. R. Oldenbourg, Munich. 1954. Pp. 24. DM. 6, annual subscription for six issues DM. 30.

The first two issues of this new periodical have already been reviewed in THE CHEMICAL AGE (1954, 70, 1309; 71, 734). The current number describes tests for mercaptans and disulphides, and also includes three further procedures for the detection of arginine. It maintains the high standard of clarity set in the previous issues and provides additional evidence of the value of this collection. The pages are perforated to facilitate binding in loose-leaf folders.—J.C.P.S.

HOME

Glucose Refinery for Scotland

Scotland's first glucose refinery, now being built at Paisley for Brown & Polson Ltd., will have a capacity output of 10,000 tons a year and will supply the entire Scottish market as well as meeting some of the demand in England and Northern Ireland. It is hoped that it will be in operation by next spring.

Chemical Club AGM

The 36th annual general meeting of the Chemical Club will be held in the Smoking Room at the Club at 2 Whitehall Court, London, S.W.1, at 5.30 p.m. on Monday, 25 October.

BWRA Open Days

The metallurgical laboratories of the British Welding Research Association are holding 'Open Days' on 23 and 24 November at 29 Park Crescent, London, W.1. Researches on both ferrous and non-ferrous alloys will be displayed covering many welding processes, including the argon-arc, metal arc and self-adjusting arc processes. Admission will be by ticket only, and people who wish to attend should write to the Secretary, BWRA, 29 Park Crescent.

Chesty Chester

Members of Chester City Council, some of whom claim that their chests have been affected by fumes from the city-centre lead-works, and others whose patience is exhausted, have approved the action of the Town Clerk, Mr. Gerald Burkinshaw, in writing to the Ministry of Health. Associated Lead Manufacturers Ltd. have spent large sums in recent years at their Chester works to prevent fumes. They are now contemplating raising their 120-ft. tall chimney another 22 ft.

Informal Evening Talks to Continue

The committee of the Chemical Club has decided to continue the experiment of arranging an informal evening talk along the lines tried a few years ago. They were discontinued because of the lack of support but revived earlier this year. The president has invited Sir Graham Cunningham, K.B.E., LL.B., to dine at the club on Thursday, 25 November. At 6 p.m. he will give an informal talk on 'Our Economic Position.

Three Hurt in I.C.I. Explosion

Three men were injured in an explosion at the I.C.I. factory at Powfoot, near Annan, on 6 October. It happened while they were dismantling steel pipes containing acetone liquid and a high explosive.

New Home for Milton

Since 9 October the head office address of Milton Antiseptic Ltd. for all administrative departments has been 42/46 Weymouth Street, London, W.1. Tel.: Hunter 0731. The telegraphic address is Miltherex-Wesdo, London. This move brings all the office departments of the firm under one roof. The factory remains at 10 Brewery Road, London, N.7.

Coal Carbonisation Retorts Opened

Extensions costing £35,000 to coal carbonisation plant owned by the Midland Rexco Co. Ltd. at Mansfield colliery, Nottinghamshire, were opened by Lord Brabazon of Tara on 6 October, when he pressed a button operating a third new carbonising retort. Each of the retorts has a capacity of 34 tons, and they are claimed to be the largest in the world.

MP Congratulates Monsanto

Mr. James Griffiths, MP for Llanelly, visited the Monsanto Chemicals Ltd. factory at Cefn Mawr on 7 October and was conducted through the departments by Mr. E. V. Weeks and Mr. J. C. Dinsdale. His visit coincided with the completion of 1,000,000 accident-free man hours at the factory, and he congratulated the management on their record.

Pyrex for Pakistan

One of the biggest orders for Pyrex scientific glassware ever supplied to the East is now being fulfilled at the Sunderland works of James A. Jobling & Co. Ltd. The order comes from the University of Sind in Pakistan, and the list includes not merely standard items such as beakers, flasks and volumetric ware, but also complete assemblies of scientific apparatus featuring Grip-Seal interchangeable ground glass joints, for use in the botanical, zoological, physics and chemistry departments. A large supply of Pyrex tubing has also been ordered for specific use in the chemistry laboratory.

OVERSEAS

Unilever Company in Italy

Unilever NV of Holland, in co-operation with the Italian Gaslini concern, has established a new company in Italy for the production and sale of margarine and edible oils for the Italian market.

Haifa Chlorine Factory

The establishment of the new chlorine factory now being built in the Haifa Port area will cost about \$2,000,000. The plant will be equipped with modern equipment, part of which is already in Israel.

US Firm Builds in Holland

A team of American specialists has arrived in Holland to work out plans for the establishment of a Dutch subsidiary of the American chemical and pharmaceutical concern, Merck & Company. The factory will be staffed by Dutch people, and is expected to be in operation before the end of the year. This is the first case of a Dutch subsidiary of an American concern being established in this particular branch of industry.

Slav Trade Pact

Exchanges of chemicals are provided for in a new trade agreement concluded between Yugoslavia and the Soviet Union. Soviet firms will export to Yugoslavia in the next few months crude oil and manganese ore; in return Yugoslav firms will export ethyl spirit, calcium carbide, caustic soda and calcinated soda.

Pakistan Oil Agreement

An agreement between the Government of Pakistan and the Standard-Vacuum Oil Company was signed in Washington on 24 September. It joins the two parties in searching for crude oil reserves in a 20,000 sq. mile area—10,000 in East Pakistan and 10,000 in West Pakistan.

Bowater Mill Inaugurated

The pulp and paper mill of Bowaters Southern Paper Corporation, a subsidiary of the Bowater Paper Corporation Ltd., of London, was formally inaugurated at Calhoun, Tennessee, on 9 October. Immediate expansion of capacity to 150,000 tons of newsprint a year by August 1955 is planned, and additional equipment is to be installed over the next two years, raising output to about 175,000 tons.

Second Oil Refinery for India

India's second oil refinery, built by Burmah Shell, is nearing completion and is expected to be ready for operation early next year. The first, owned by Standard Vacuum, started production in July.

Belgian Nuclear Energy Syndicate

A nuclear energy planning syndicate has been formed in Brussels. The chief shareholders are a number of chemical manufacturers and electrical and metallurgical companies, with the Union Minière du Haut-Katanga and the Société Générale de Belgique.

Swedish Ore Concentration Plant

The largest ore concentration plant in Europe, at Boliden, Northern Sweden, was inaugurated in the middle of September. It has a capacity of 500,000 tons a year and forms part of a five-year expansion programme launched by the Boliden Mining Company. The known ore deposits of Boliden amount to 42,000,000 tons. Iron and copper pyrites, galenite and zinc-blende are the most richly represented minerals, but gold and silver are also extracted.

New Detergent from Sugar

Laboratory experiments indicate that a new detergent made from sugar may soon be ready for commercial production, the president of the US Sugar Research Foundation, Dr. Henry B. Hass, announced recently. The detergent is now being produced experimentally. It is described as 'effective, mild and inexpensive.' Work is also progressing on the use of sugar and its by-products for plastics, fibres, rubbers, solvents, insecticides and adhesives.

Courtaulds to Extend US Plant

Courtaulds Ltd. are to treble the capacity of their viscose rayon staple plant at Le Moyne, Alabama, USA. The work will be carried out in two stages, and the first is expected to be completed by the end of next year. It will double the plant's capacity to 100,000,000 lb. a year. The second stage is designed to bring output up to 150,000,000 lb. a year. The company state that since the plant was completed last year the present capacity has become insufficient to satisfy demand.

PERSONAL

At Trinity College, Cambridge, Dr. J. T. BRAUNHOLTZ has been elected to a research fellowship in chemistry, and Mr. J. B. CHAPPELL to a research fellowship in biochemistry.

MR. EUSTACE FARMILOE, a director and chief chemist of T. and W. Farmiloe Ltd., paint manufacturers, left England on 4 October for South Africa at the request of building contractors there to study the effect of heat on putties and other mastic compositions.

Owing to pressure of business, SIR KENNETH HAGUE, deputy chairman and managing director of Babcock & Wilcox Ltd., has been compelled to resign his chairmanship of their associated company, Edwin Danks & Co. (Oldbury) Ltd. GENERAL SIR KENNETH CRAWFORD, K.C.B., M.C., has been appointed a director of Edwin Danks and chairman in succession to Sir Kenneth Hague. Following a distinguished career in the Royal Engineers, General Crawford was deputy chief of the Imperial General Staff from 1947 to 1949 and Controller of Supplies (Munitions) in the Ministry of Supply until 1953.

British Celanese Ltd. have announced the award of research studentships in chemistry, tenable for two years from 1 October, to MR. R. B. PEARSON (University College, London), MR. A. M. NORTH (University of Birmingham), MR. J. L. TAYLER (Imperial College, London) and MR. R. L. VALE (University of Birmingham).

Officers of the Purchasing Officers' Association for 1954-55 are: President, MR. F. J. WHITE (Chance Brothers Ltd.); vice-presidents, MESSRS. E. W. BEAUMONT (S. M. Wilmot & Co. Ltd.), J. FERGUSON (United Ebomite & Lorival Ltd.), H. D. LEATHER (I.C.I. Ltd., Alkali Division), O. A. PALLETT (British Thomson-Houston Co. Ltd.), A. ROCHESTER (Hawthorne Leslie (Engineers) Ltd.), C. L. WRIGHT (Westinghouse Brake & Signal Co. Ltd.); chairman of council, MR. R. J. MITCHELL (The Morgan Crucible Co. Ltd.); vice-chairman, MR. H. C. EXELL (North Thames Gas Board); hon. treasurer, MR. C. F. HUEBNER (British Oxygen Co.).

MR. HARRY W. HOWARD, supervisor of surface coating resins in the technical service laboratories of the Shell Chemical Corporation, is in England this month following an extensive tour of Western Europe. Mr. Howard is demonstrating a new sales technique which has proved very successful in America and is also advising paint manu-

facturers and other users on Shell epoxide resins for which the trade name in the US is Epon and in Europe Epikote. Mr. Howard is a graduate in chemical engineering of the Virginia Polytechnic Institute and he had wide experience of industrial surface finishes before joining Shell in 1949;



first with the Egyptian Lacquer Manufacturing Co. where he was responsible for the development of synthetic resin finishes and later as chief chemist with the Beckwith Chandler Manufacturing Co. and in the Resin Division of the United States Industrial Chemicals Co. In 1942 he was loaned to the Chemical Bureau of the War Production Board, soon being appointed chief of the Petroleum Derivatives Unit and Administrator of Aromatic Solvents, Naphthenic Acids and Chlorinated Paraffins. During the past five years he has addressed nearly every paint production club in the US and Canada, describing the properties of epoxide resins and their uses in surface coatings.

MR. J. W. C. MILLIGAN has relinquished his position as managing director of Brush Electrical Engineering Co. Ltd., of Loughborough, a subsidiary company of the Brush Group.

MR. L. L. BOTT, general works manager of Davey, Paxman & Co. Ltd., has been appointed to the board of the company. MR. A. G. HOWE, chief engineer of the company, and MR. T. L. KENDALL, sales director of Ruston & Hornsby Ltd., the parent company, have also been appointed directors of Davey, Paxman & Co. Ltd.

MR. A. F. LAUDER and MR. J. FELL have been appointed directors of Lansil.

New honorary secretary of the Society of Cosmetic Chemists of Great Britain is MR. F. RILEY. He succeeds MR. S. J. PALLING, who has taken a post in Eire.

Colvilles Ltd. announce that MR. WILLIAM BARR, chief metallurgist of the group, and MR. R. P. TOWNDROW, until recently works manager of the Clyde Iron Works, have been appointed directors. MR. J. KERR, senior, has resigned from the board of the Etna Iron & Steel Company, the share capital of which was recently transferred to Colvilles by the Iron and Steel Holding and Realisation Agency. MR. R. MARSHALL and MR. S. THOMSON, of Colvilles, have been appointed directors.

The Council of the Royal Society has appointed PROFESSOR M. L. E. OLIPHANT, F.R.S., of the Australian National University, as the Rutherford Memorial Lecturer for 1955. Professor Oliphant will deliver lectures in India and Pakistan.

MR. S. R. BROCKBANK has been appointed secretary of The Society of British Soap Makers in succession to MR. C. F. H. HIRST. The society takes the place of the now dissolved Soap Makers' and Fat Splitters' Federation. The offices of the Society of British Soap Makers are at Hesketh House, Portman Square, London W.1; Tel. WELbeck 4466.

MR. BRIAN H. TURPIN, managing director of QVF Ltd., of Stone, Staffordshire, suppliers of 'Visible Flow' glass pipeline and 'Quickfit' industrial glassware, has recently returned from a visit to the USA and Canada. Accompanied by DR. E. M. MEADE, of Toronto, QVF distributor for the area, Mr. Turpin visited a number of installations of the company's products.

SIR BEN LOCKSPEISER, secretary of the Department of Scientific and Industrial Research, has been elected first president of the recently established European Organisation for Nuclear Research.

MISS GENE WHEWELL, daughter of a Radcliffe chemical manufacturer, is to be married at St. Peter's Church, Bury, on 9 November, to MR. ALAN OLIVER, Britain's leading show jumper.

PROFESSOR H. HEIMANN, Dean of the Faculty of Chemical Engineering at the Technion, Israel Institute of Technology, Haifa, is at present visiting this country. After reading a paper before the International Congress of Industrial Chemistry in Brussels, he came to Britain to visit the principal soil research stations, the Macaulay Institute, Jealott's Hill, and Rothamsted. He has also visited a number of chemical engineering schools to study administration.

Obituary

The death has occurred in Edinburgh of DR. PHILIP EGGLETON, D.Sc., who since 1930 had been at Edinburgh University, first as lecturer, then as reader in biochemistry. For nearly 20 years he had been responsible for the teaching of biochemistry to medical students and more recently was in charge of the teaching of physiology and physiological chemistry to science students. Dr. Eggleton, who was 51, published about 40 original papers and reviews, was part author of several books and was well known for his radio talks on scientific topics.

De-Caking

Scottish Agricultural Industries Ltd., after months of research at their new Leith laboratories, claim to have removed the risk of caking from compound granular fertilisers based on superphosphates if they are stored in reasonable conditions. A spokesman said: 'We do not want to imply that all fertilisers caked under average conditions.' He added that they had simply removed the risk of caking so far as these fertilisers were concerned.

The Pay Packet

Average weekly earnings in the chemical and allied trades in the last pay week of April were £8 14s. 6d., according to the *Ministry of Labour Gazette*. Men over 21 earned on an average £10 1s. 6d. in a week of 48.4 hours and women £5 3s. in 42½ hours. Highest paid were those engaged in mineral oil refining, in which the average weekly earnings were £10 4s. 6d.

Fisons' Research Station

Fisons Ltd. announce that they have awarded the contract for the main laboratory buildings of their new research station at Levington, Suffolk, to Messrs. J. Gerrard and Sons Ltd. of Manchester.

Publications & Announcements

THE Rolla-bench, produced by the Shandon Scientific Company, S.W.7, is claimed to tackle 'one of the biggest problems encountered in every laboratory and workshop, namely the shortage of bench space.' As described in the company's leaflet, the Rolla-bench provides 18 in. by 24 in. (or 24 in. by 30 in. with the flap up) extra bench space. It is rigidly connected and level with the permanent bench or table but can be immediately moved to a new position.

FIELD tests on wood preservatives have been carried on at the Forest Products Research Laboratory since 1928. Results obtained up to the end of 1953 on preservatives normally applied under pressure are given in 'Field Tests on Wood Preservatives Used for Pressure Treatment,' Forest Products Research Bulletin No. 32, published by HMSO for DSIR, price 2s. 6d. A certain amount of information about the toxicity of preservatives and its endurance can be learned from laboratory tests but at present the only satisfactory method of measuring their effectiveness is the field test. It may take 10 to 20 years to obtain useful results by this method. The tests reviewed are limited to those on preservatives normally applied under pressure. These are comparatively few and of two types—oils and water soluble salts. The oil preservatives include coal tar creosote and mixtures of coal tar creosote with a mineral oil or with coal tar. Solutions of copper naphthenate or pentachlorophenol in a mineral oil are also used. The principal water-soluble preservatives are various proprietary mixtures of salts available under trade names.

THE latest publication of Dawe Instruments Ltd. describes how the firm's products help production in various industries. The booklet is illustrated with photographs, diagrams and cartoons, to illustrate section headings. It describes instruments for the measurement of noise (defined in a British Standard as an unpleasant sound), vibration analysis, the ultrasonic measurement of wall thickness and dynamic balancing. There is also a section on industrial applications of modern stroboscopes. Copies of the booklet are obtainable free of charge from Dawe Instruments Ltd., 99 Uxbridge Road, London W.5.

AN OVEN designed by the General Electric Co. Ltd., Kingsway, London W.C.2, for drying powders and chemicals has provision for a great number of charge-carrying trays. A forced air circulation system ensures that the air flow is parallel to the tray surfaces. The oven chamber is heated by wire wound elements mounted in a separate compartment arranged as a drawer for easy access. A centrifugal fan on the top of the oven supplies the air flow which passes over the heating elements and is diffused down the oven side before passing horizontally across the chamber. An outlet is provided for purging moisture laden air from the oven. An oven with internal dimensions of 4 ft. 6 in. by 4 ft. 6 in. by 3 ft. deep can be arranged to accommodate 60 work trays in three columns, and to provide temperatures up to 200°. The oven can be supplied in a range of sizes to take two, three, or four columns of trays.

THE August issue of *Evershed News*, publication of Evershed & Vignoles Ltd., Chiswick, London, describes a new control desk supplied by the firm for the catalytic-polymerisation unit at the Grangemouth refinery of Scottish Oils Ltd. Among other items are details of equipment supplied to the Toronto Transport Commission, Orient liners and the royal yacht, *Britannia*.

THE design of all laboratory furnaces made by A. Gallenkamp & Co. Ltd., of 17-29 Sun Street, London, E.C.2, has recently been the subject of careful review. As a result, Catalogue No. 558, recently issued by the firm, presents an augmented range of furnaces, modern in appearance and incorporating the latest methods of control. The catalogue, which is illustrated, gives details of furnaces designed for both general and specific purposes. In addition to the original wire-wound crucible, muffle and combustion furnaces for working temperatures of 1,000°C, other types suitable for higher temperatures have been made available. These include a low voltage combustion furnace with a spiral heating element of alloy rod for temperatures of 1,250°C and combustion and muffle furnaces with silicon carbide elements suitable for 1,400°C and 1,350°C respectively.

Law & Company News

Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur.

Mortgages & Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described herein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages or Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary but such total may have been reduced.)

NITRAM METAL TREATMENT & ENGINEERING CO. LTD., Hayes (Middlesex). 1 September, mortgage to Co-operative Permanent Building Society securing £7,000 and any other moneys, etc.; charged on factory and office premises at Silverdale Road, Hayes (Middlesex). *£7,000. 18 August, 1954.

Satisfactions

BRITISH CELANESE LTD., London, W. Satisfaction, 18 September, of debenture stock registered 24 September, 1945, to the extent of £616.

Increases in Capital

The following increases in capital are announced:—**LAWFER CHEMICAL CO. LTD.**, from £4,002 to £50,000; **PERMUTIT CO. LTD.**, from £24,000 to £790,000; **BEECHAM GROUP LTD.**, from £5,500,000 to £8,000,000; **FOAM-ITE LTD.**, from £20,000 to £75,000.

Company News

Stream-Line Filters Ltd.

Stream-Line Filters Ltd. have declared an interim dividend of $\frac{7}{8}$ per cent for 1954 on the £100,000 capital, against 5 per cent for each year since 1945.

Greeff-Chemicals Holdings

The directors of Greeff-Chemicals Holdings have declared an interim dividend of $\frac{3}{4}$ per cent on account of 1954 on a capital doubled to £400,000 in June. Trading results this year are on a higher level than in the same period of last year, and the directors anticipate that the total Ordinary dividend for the year should not be less than the $\frac{1}{2}$ per cent forecast in the chairman's last address on the increased capital.

Peter Brotherhood Ltd.

Net profit of Peter Brotherhood Ltd. for the year ended 31 March was £174,904, against £138,546, and the dividend recommended for the annual meeting on 2 November is 30 per cent, compared with 18 per cent. Fixed assets expanded from £334,955 to £491,804 during the year, reflecting plant and machinery in the course of construction of £115,492 (nil).

Sadler & Co. Ltd.

The directors of Sadler & Co. Ltd. recommend a dividend of 10 per cent for the year ended 30 June, against 6 per cent for the previous year, and also propose a one-for-two free scrip issue in 'A' Ordinary (non-voting) shares. The directors hope to maintain the dividend in future on the increased capital. Net profit after taxation for the year was £82,542, compared with £12,316.

George Cohen Sons & Co. Ltd.

The directors of George Cohen Sons & Co. Ltd. have decided that the raising of new capital referred to in the chairman's annual statement will be in the form of an issue of £1,000,000 $\frac{4}{5}$ per cent unsecured loan stock, 1965-70, to ordinary and preference holders registered on 29 September. The new loan stock is priced at 97 per cent payable as to 10 per cent on application, 15 per cent on allotment and 72 per cent on 14 January. Letters of allotment will be renounceable until the final payment date.

Du Pont of Canada Securities Ltd.

Du Pont of Canada Securities Ltd., holding company for Du Pont Company of Canada Ltd., has declared an initial dividend of 10 cents per share on the no par value common stock payable 29 October, to shareholders of the register on 30 September. Du Pont Company of Canada Ltd. is one of the two successor companies of Canadian Industries Ltd., which was segregated on 1 July into two separate corporate entities. The other successor company is Canadian Industries (1954) Ltd. Du Pont Securities is the principal stockholder in Du Pont Company of Canada Ltd.

Explosives & Chemical Products Ltd.

Net trading profit of Explosives and Chemical Products Ltd. for the year to 30 June was £154,234, against £130,808. Balance

after tax is £56,450 (£40,416 plus reduction of subsidiary loss provision £1,700 and tax relief on flood damage £10,00). The directors state that the factory at Bramble Island has now been substantially restored at a cost considerably below the first estimate.

Glaxo Laboratories Ltd.

The directors of Glaxo Laboratories Ltd. recommend a final dividend of 15 per cent to make 20 per cent for the year ended 30 June, against 17½ per cent last year. They also propose to increase the capital to £5,000,000 and subject to CIC consent to capitalise £1,592,700 of reserves in a 100 per cent scrip issue. Group profits totalled £1,484,000 (£1,585,025).

Pest Control Ltd.

The directors of Pest Control Ltd. have passed the half-yearly payment on the £350,000 6 per cent cumulative preference capital normally due on 30 September. A cash offer of 22s. 6d. per £1 preference share from Fisons Ltd. was accepted by holders of 99 per cent of the issued shares in August.

Change of Address

Bayer Products Ltd. are moving to larger administrative headquarters at Neville House, Eden Street, Kingston-on-Thames, Surrey. Tel.: Kingston 7733. The move takes effect from 30 October, and the associated export company, Winthrop Products Ltd., is also moving to Kingston.

The Sulphur Problem

DURING the past few years problems arising from the presence of sulphur in the fuels used in this country for domestic and industrial purposes have been steadily increasing. One of the factors involved has been the increasing size of industrial units in this country; power stations, for example, are becoming larger, so that atmospheric pollution from the fuels used tends to become concentrated in smaller areas. In manufacturing processes where sulphur has a deleterious effect on the products, as for example in the iron and steel industry, it is not always easy to select fuels and raw materials of low sulphur content, or to adjust the flowsheet to minimise the sulphur content of the final products.

The most important factor, however, has been the steadily increasing sulphur content in the coals available in this country as the

better-class seams are worked out, and this has brought about a number of deleterious consequences in a wide range of industries as well as affecting the national health and increasing corrosion losses.

Consequently the Institute of Fuel arranged a conference on 'The Special Study of Sulphur Removal and Recovery from Fuels,' which was held in London on 6 and 7 October. The reprinted papers from this conference may be obtained from the Institute at 18 Devonshire Street, Portland Place, London, W.1, price 2 guineas.

Market Reports

LONDON.—Business on the industrial chemicals market has remained fairly brisk with a steady flow of new buying orders for spot and nearby requirements, while the movement against contracts is well up to schedule. Prices generally are firm but unchanged with the exception of the non-ferrous metal compounds which are dearer. Among the coal tar products there has been a better call for pitch deliveries on home and export account and available supplies of creosote oil and phenol are quickly absorbed.

MANCHESTER.—Inquiry for heavy chemical products on the Manchester market during the past week seems to have been well maintained and a fair weight of new business has been placed. In addition, contract deliveries to home users of the soda and potash compounds as well as most other leading heavies keep up satisfactorily, and the same applies to shipping movements. So far as prices are concerned there is little sign of easiness in any direction. Bookings of any consequence in the fertiliser section are confined to a few lines. A steady demand for most of the light and heavy tar products has again been reported.

GLASGOW.—The labour unrest in the south has upset the calculations of some manufacturers here, particularly due to the hold up in metals. Because of the temporary shortage, prices have also been unsteady with higher prices again being asked for copper derivatives. Generally speaking, the activity experienced throughout the trade during the last 2/3 weeks has been maintained and a satisfactory period of trading is reported from practically all sections. The export market has again been brisk with a fair percentage of orders.

Next Week's Events

MONDAY 18 OCTOBER

The Royal Institute of Chemistry

Dartford: Technical College, 7.30 p.m. 'Manufacture and uses of Hydrogen Peroxide' by W. S. Wood.

The Chemical Society

Leicester: University College, 5 p.m. 'The Stereochemistry of Catalytic Hydrogenation' by Professor R. P. Linstead.

Cardiff: Chemistry Department, University College, 5.30 p.m. 'Some applications of electron diffraction to problems in inorganic chemistry' by Dr. L. E. Sutton.

Society of Chemical Industry

London: The Royal Institution, Albemarle Street, Piccadilly, 6 p.m. Inaugural meeting of Pesticides Group, followed by inaugural dinner at the Park Lane Hotel.

The British Ceramic Society

Stoke-on-Trent: North Staffordshire Technical College, 7.30 p.m. Joint meeting of Pottery Section with the Midlands branch of the Royal Institute of Chemistry. 'Some applications of organic compounds in the ceramic industries,' by Dr. W. L. German.

The Institute of Metals

Hillington: Visit by Scottish Local Section to Renfrew Foundries Ltd.

Sheffield: University Buildings, St. Georges Square, 7.30 p.m. 'Metallurgical problems of atomic energy,' by L. Rotherham.

Institute of Metal Finishing

London: Northampton Polytechnic, St. John Street, E.C.1, 6.15 p.m. 'Ion exchange in the metallurgical industries' by Dr. R. E. Kressman.

TUESDAY 19 OCTOBER

Society of Chemical Industry

London: Chemical Society's rooms, Burlington House, Piccadilly, 6.30 p.m. Plastics and Polymer Group. 'Recent investigations in the field of vinyl polymerisation' by Dr. C. H. Bamford (Courtaulds Ltd.).

London: Geological Society, Burlington House, 5.30 p.m. Chemical Engineering Group. Film: 'Corrosion in action.'

The Institute of Fuel

Birmingham: James Watt Institute, Great Charles Street, 6 p.m. Chairman's address on 'Fuel and the ceramic industry' by E. B. Gibbons.

North-East Metallurgical Society

Middlesbrough: Cleveland Scientific and Technical Institution, 7.15 p.m. 'The application of gaseous oxygen to open hearth and converter steelmaking' by D. J. O. Brandt.

Textile Institute

Blackburn: Visit to Scapa Dryers Ltd.

WEDNESDAY 20 OCTOBER

The Royal Institute of Chemistry

Isleworth: Grammar School, Ridgeway Road, 7 p.m. 'The use of photography in scientific and engineering investigations' by Dr. R. H. Herz.

Institution of Chemical Engineers

London: All-day visit to the Kemsley and Sittingbourne paper mills of the Bowater Paper Corporation.

Liverpool Metallurgical Society

Neston: Visit to Morgan Refractories Ltd.

Incorporated Plant Engineers

Rochester: Bull Hotel, 7 p.m. 'Recent research in pressure vessels' by P. H. R. Lane, British Welding Research Association.

THURSDAY 21 OCTOBER

The Chemical Society

Hull: Chemistry Department, the University, 6 p.m. 'The work of the British Rubber Producers' Research Association' by Dr. L. C. Bateman.

Sheffield: Chemistry lecture theatre, the University, 7.30 p.m. 'The Polymerisation of sulphur' by Professor G. Gee.

Aberdeen: Robert Gordon's Technical College, 7.30 p.m. 'Some aspects of the chemistry of amino-sugars' by Professor M. Stacey. Joint meeting with the Royal Institute of Chemistry and the Society of Chemical Industry.

Institution of Chemical Engineers

Manchester: Students' Common Room, College of Technology, Sackville Street, 6.45 p.m. Lecture on gas turbines.

Society of Leather Trades Chemists

Northampton: College of Technology, 2.30 p.m. 'Colour measurement' by J. S. Mudd.

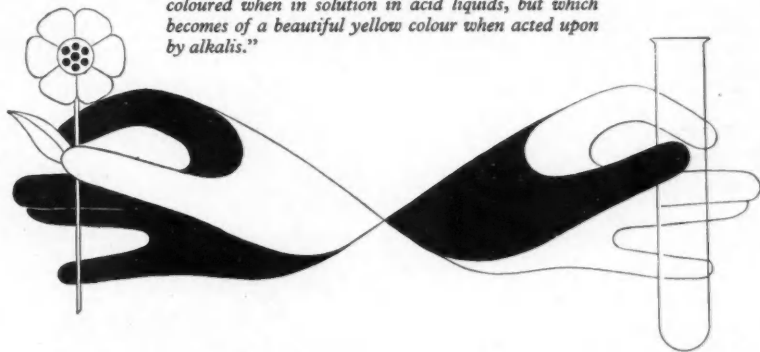
Incorporated Plant Engineers

Blackburn: Golden Lion Hotel, 7.30 p.m. 'Trade effluent and sewage disposal' by G. Ainsworth.

[continued on page 850]

An examination by M. Filhol

"Vegetable Colouring Matters:—M. Filhol has been engaged in the examination of vegetable colouring matters, and has discovered some facts which he now publishes as briefly as possible, intending to give all the details in a longer memoir. There exists in nearly all flowers, says M. Filhol, a substance which is scarcely coloured when in solution in acid liquids, but which becomes of a beautiful yellow colour when acted upon by alkalis."



M. FILHOL'S DISCOVERIES were made nearly a hundred years ago. This early note of them appeared in the first volume of 'Chemical News', published in 1860.

Natural dyes have long been superseded as indicators by the highly purified synthetic dye compounds used to-day for colorimetric measure-

ments of hydrogen ion concentration, oxidation-reduction balance and adsorption capacity. Theory and practice in these fields are explained in three B.D.H. booklets—'pH Values', 'The Colorimetric Determination of Oxidation-Reduction Balance' and 'Adsorption Indicators'—which may be obtained free on request.

LABORATORY B·D·H CHEMICALS

THE BRITISH DRUG HOUSES LTD. B.D.H. LABORATORY CHEMICALS GROUP POOLE DORSET

LC/P/8

Next Week's Events

continued from page 848

FRIDAY 22 OCTOBER

The Royal Institute of Chemistry

Oxford: University Physical Chemistry Laboratory, 7.15 p.m. 'Symposium on radio-chemistry' (with the Society for Analytical Chemistry, Physical Methods Group).

The Chemical Society

Glasgow: Chemistry Department, the University, 3.30 p.m. 'Some recent advances in carbohydrate chemistry' by Professor M. Stacey.

Birmingham: Chemistry Department, the University, 4.30 p.m. 'Some recent advances in the stereochemistry of polycyclic hydroaromatic compounds' by Dr. J. Walker.

Cambridge: Chemical Laboratory, the University, 8.30 p.m. 'Gas-liquid chromatography' by Dr. A. J. P. Martin.

Plastics Institute

Manchester: The Engineers' Club, Albert Square, 6.30 p.m. 'Injection moulding efficiency and the importance of "gating"' by E. Gasper.

SATURDAY 23 OCTOBER

Royal Institute of Chemistry & Society of Chemical Industry

Manchester: Midland Hotel, 6 p.m. for 6.30 p.m. Dinner Dance.

Awards for Long Service

THE Eaglescliffe Chemical Co. Ltd., Co. Durham, has made 57 long service awards to employees, 37 of whom are still with the firm, it is reported in the October issue of the *Tees-Side Journal of Commerce*.

Last month the chairman, Mr. J. C. Hutton-Wilson, presented wrist watches to 16 of them who had each completed 25 years with the company. He pointed out that during the whole of its 120 years and more the company had been run by his family. Mr. Hutton-Wilson said he wanted it to remain a family concern, even though its ramifications were greater than before.

The firm's directors, Mr. A. C. J. Burningham, Mr. G. R. Dixon, Mr. W. H. Morrow and Mr. T. Williams, with the general works manager, Mr. L. W. Grainge, attended the ceremony.

IN AID OF THE JOHN BENN BOYS HOSTELS ASSOCIATION

(At King George's House, Stockwell, the Association maintains the largest residential boys' club in the U.K.)

"A PENNY FOR A SONG"

A Play by

John Whiting

will be presented at the SCALA THEATRE
on

Wednesday, December 1st, 1954

at 7.30 p.m.

by THE STOCK EXCHANGE DRAMATIC AND
OPERATIC SOCIETY

PRICES OF ADMISSION (all seats reserved)
Orchestra Stalls and Dress Circle £1/1/-, 15/-, 10/6
Stalls - - - - - 7/6, 5/-
Circle - - - - - 7/6, 6/-
Upper Circle - - - - - 3/-

Order tickets to-day for yourself and Staff

From: R. D. HOWELL, BENN Brothers, Ltd.,
154 Fleet Street, London, E.C.4

Filter Crucibles of Porous Porcelain

retain the finest precipitates and filter rapidly. They are not affected by acids, remain constant in weight within very fine limits and can be heated to high temperatures.

Made by

**The WORCESTER
ROYAL PORCELAIN CO. LTD.**

and

Supplied by all recognised Laboratory
Furnishers

Vochema '54

Machinery and apparatus for the industrial production and conditioning in the food-processing and the chemical and pharmaceutical industries.

Utrecht - Netherlands
20-27 October



90 participants
38,500 sq. feet nett exhibition space

The "Vochema '54" is held in the "Margriet" hall at the site of the Utrecht Fair situated Graadt van Roggenweg and is open daily from 9 a.m. till 5 p.m.; Monday 25th and Tuesday 26th October also from 7.30 p.m. - 10 p.m.; closed on Sunday 24th October.

CLASSIFIED ADVERTISEMENTS

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive, or a woman aged 18-59 inclusive, unless he or she, or the employment, is excepted from the provisions of the Notifications of Vacancies Order, 1952.

A. BOAKE, ROBERTS & CO., LTD., require the services of **SHIFT CHEMISTS** for Plant Control work. Academic qualifications will be an advantage, but less essential than industrial experience. The work is interesting and varied, and the appointments will be progressive. There is every opportunity for advancement. Initial salary will be in the range of £600 to £700 per annum. Applications plainly marked "Shift Chemists" to **PERSONNEL MANAGER, A. BOAKE, ROBERTS & CO., LTD.**, 100, CARPENTERS ROAD, LONDON, E.15.

BRITISH TITAN PRODUCTS COMPANY LIMITED—a rapidly expanding Heavy Chemical Industry—has staff vacancies at its Grimsby (Lines) and Billingham (Co. Durham) Factories as follows:—

TECHNICAL OFFICERS (GRADUATE CHEMISTS AND CHEMICAL ENGINEERS) to assist in the development of Chemical Plant operations. Previous experience of Chemical Plant would be useful but is not essential.

ASSISTANT TECHNICAL OFFICERS with qualifications up to Inter. B.Sc. standard, and experience in Chemical Plant operations.

Applicants should preferably be under 30 years of age. Conditions of work and service are very attractive and there are Staff Bonus and Superannuation Schemes. Commencing salary dependent on age, qualifications and experience.

Application forms may be obtained from the **PERSONNEL MANAGER, BRITISH TITAN PRODUCTS COMPANY, LIMITED, KRONOS HOUSE, COPPERGATE, YORK.**

PUBLIC SERVICE OF SOUTH AUSTRALIA

Applications are invited for positions of
CHEMISTS AND ANALYSTS
in the

SOUTH AUSTRALIAN PUBLIC SERVICE.

CHEMISTS should hold a Degree in Science (with Chemistry as a major subject), or a Diploma in Industrial Chemistry or equivalent.

ANALYSTS should hold a Degree in Science (with Chemistry as a major subject), or a Diploma in Industrial Chemistry or associateship of a recognised Chemical Institute or equivalent. For some analysts a Degree in Science (with Inorganic Chemistry and Organic Chemistry or Biochemistry as major subjects) is required. The subjects Bacteriology I and/or Biology I, if included, would be an advantage.

Salaries range from A£557 to A£1,347 per annum, and commencing salary and maximum salary will be determined in accordance with the appointees' qualifications and experience.

Further particulars may be obtained from the
**AGENT-GENERAL & TRADE COMMISSIONER
FOR SOUTH AUSTRALIA,
SOUTH AUSTRALIA HOUSE,
MARBLE ARCH, W.1.**

SITUATION WANTED

YOUNG SWISS CERTIFICATED

CHEMIST
with absolved apprenticeship as Mechanician, desires

POSITION IN CHEMICAL PLANT.

Fair knowledge of English.

Apply for particulars to:

EGGER,

**P.O. BOX AARAU
(SWITZERLAND).**

FOR SALE

CHARCOAL, ANIMAL AND VEGETABLE
horticultural, burning, filtering, disinfecting, medicinal, insulating; also lumps ground and granulated; established 1830; contractors to H.M. Government.—**THOS. HILL-JONES, LTD., "INVICTA" WORKS, BOW COMMON LANE, LONDON, E. TELEGRAMS: "HILL-JONES, BOCHURCH LONDON." TELEPHONE 3285 EAST.**

DEVIL DISINTEGRATOR, "Hardy Patent Pick Co." Grinding chamber approx. 30 in. diam., pulley 8 in. diam. by 6 in. face.

One Ditto. Grinding Chamber 22 in. diam., pulley 8 in. diam. by 3 in. face.

GRAVITY ROLLER CONVEYOR—2½ in. rolls, 12 in. to 18 in. wide, 3 in. to 6 in. pitch, in various lengths. Good condition.

**THOMPSON & SON (MILLWALL), LIMITED,
MILLWALL,
LONDON, E.14.
TEL. EAST 1844.**

ECONOMIC BOILERS, Two Brand New 14 ft. by 8 ft. by 150 lb. w.p. **IMMEDIATE DELIVERY**
400 other Boilers in stock.

STAINLESS PRESSURE TANK, 19 ft. by 5 ft. diam., 110 lb. w.p. Unused.

Whessoe Riveted Steel **MIXING TANK**, 13 ft. diam. by 15 ft. deep, 9-16 in. plate, cone base.

TWO 35 ft. long by 9 ft. diam. Lead-lined **TANKS**.

SIX Stainless Steel **JACKETED PANS**, 60 galls.

TWO Broadbent **WATER-DRIVEN CENTRIFUGES**,

30 in. diam., 12 in. deep, 1,150 r.p.m.

SIX Aluminium **CONDENSERS**, 14 ft. long by 2 ft. 6 in.

diam. 386 Tubes, ½ in. o.d.

FORTY Riveted **RECEIVERS**, 8 ft. 6 in. long, 5 ft. 6 in.

diam., 75 lb. w.p. Numerous other sizes.

Solid Drawn **STEEL PIPES**, 6 in., 8 in., 10 in., 12 in.,

14 in., thousands of feet in stock, plain and flanged.

CAST-IRON PIPES, 400 yds. 8 in. **NEW. Also most**

other sizes, up to 24 in. bore.

VALVES in Stainless, Gunmetal, Enamel Lined.

Free Catalogue. "Watkins Machinery Record," available.

CAST IRON TANK PLATES, 2 ft. square. 500 in stock.

FRED WATKINS (BOILERS), LTD.,

COLEFORD, GLOS.

NEW 12½ and 16-gallon **MILD STEEL DRUMS**, suitable for liquids. Immediate delivery. Inquiries invited. **STEEL DRUMS, LIMITED, 116, BURDON LANE, SUTTON, SURREY.**

ONE Complete Copperplating Plant, with all accessories and electrical Rectifying Equipment. Full details from **WHITEFIELD MACHINERY & PLANT, LIMITED, COBDEN STREET, SALFORD, 6. (TEL. NO. PEN. 4746)**

FOR SALE

C. BARBER, LTD.

SEVERAL HORIZONTAL JACKETED TILTING MIXERS, 25 gallons capacity. New and unused. 500-gal. Over-driven M.S. **MIXING VESSEL**. M.S. pressure filter, 4 ft. 3 in. diam. by 5 ft. 3 in. overall height.

CANNON STEAM JACKETED ENAMEL-LINED PANS 10 and 25 gallons. All new and unused.

DOULTON 25-gal. COPPERS with lids. NEW and unused. **WELDED VESSELS** of all types, in mild steel or stainless steel. Fabricated to customer's specifications.

HORIZONTAL TRIPLE ROLL MILLS with chilled iron rolls, in excellent condition. Various sizes.

C. BARBER LTD.
SILVERDALE GARDENS
HAYES MIDDLESEX

Telephone—Hayes 2735/6

FOR DISPOSAL—

17.233 tonnes American Oxide U.O.P. Spec. 12% Cr 203 on alumina, $\frac{1}{2}$ in. by $\frac{1}{2}$ in. pellets.

In 87-200 K. drums.

12.509 tonnes American Oxide I.C.I. Spec. 12% Cr. 203 alumina, $\frac{1}{2}$ in. by $\frac{1}{2}$ in. pellets.

In 62-200 K. and 1-184 K. drums.

13.356 tonnes American Oxide I.C.I. Spec. 12% Cr 203 on alumina, $\frac{1}{2}$ in. by $\frac{1}{2}$ in. pellets.

In 66-200 K. and 1-156 K. drums.

Offers for purchase of the above catalyst are invited.

The Oxides may be viewed at Heysham Refinery, by arrangement with Messrs. Trimpell, Ltd., Middleton, Nr. Morecambe, Lancs.

MINISTRY OF FUEL & POWER, CONTRACTS BRANCH, THAMES HOUSE SOUTH, MILLBANK, S.W.1.

PHONE 98 STAINES

"KESTNER" LEAD-LINED ENCLOSED AUTO-CLAVE—approx. 6 ft. by 4 ft. 10 in. diam., with **"ANCHOR"** Mixer.

"CHRISTY & NORRIS" PULVERISER—24 in. by 18 in.

(Unused) **PORTABLE ELECTRIC STIRRING ARMS**—400/3/50.

"PERKINS" JACKETED TWIN "Z" BLADE TILTING MIXER—steel pan 29 in. by 29 in. by 22 in. 400/3/50.

No. 2 **"DE LAVAL" EMULSOR**—15 in. by 15 in. Stainless steel jacketed container.

"CARTER" HEAVY SPIKED ROLL CRUSHER—18 in. by 12 in. diam.

No. 3 **ELECTRIC DRIVEN KEK MILL**. 1,400 gal. **WELDED STEEL MIXING TANK**—7 ft. by 6 ft. deep.

JACKETED RECTANGULAR VACUUM OVEN—8 ft. by 3 ft. 6 in. by 4 ft.

1,000 and 1,500 gal. **ALUMINIUM ENCLOSED TANKS, PUMPS, PANS, FILTER PRESSES, BOILERS, HYDROS, CONDENSERS, STILLS, OVENS, DRYERS AND TANKS** up to 44,000 gallons.

HARRY H. GARDAM & CO., LTD.
STAINES.

SACK AND BAG MERCHANTS AND MANUFACTURERS. New and reconditioned for Home and Export. (Use JUTEX for sack repairing). **ALTRINCHAM JUTE LTD., WRIGHT STREET, BROADHEATH ALTRINCHAM, CHESHIRE. ALTRINCHAM 4360.**

FOR SALE

600

TABLETTING MACHINES

DANIELS No. 3 SINGLE PUNCH—for tablets up to 2 $\frac{1}{2}$ in. diam. by 1 $\frac{1}{2}$ in. thick, 26 per minute. Maximum filling depth, 3 in. Complete with feed hopper. Motorised 400/440/3/50.

TWO BRADLEY & TURTON P2 SINGLE PUNCH. Tablets up to 1 $\frac{1}{2}$ in. diam. by $\frac{1}{2}$ in. thick, 35 per minute. Adjustable filling depth with agitated hopper.

STOKES RD3 Rotary Machine for tablets up to 1 in. diam. Output 300-350 per minute. Maximum filling depth, $\frac{3}{4}$ in. At present fitted 15 sets of punches and dies for $\frac{1}{2}$ in. diam. tablets. Stainless steel hopper.

MANESTY RD3 16-punch Rotary Machine for tablets up to $\frac{1}{2}$ in. diam. Output 300-350 per minute. Maximum depth of fill, $\frac{3}{4}$ in. Fitted stainless steel hopper and motorised 400/3/50.

WILKINSON SINGLE PUNCH—for tablets up to $\frac{1}{2}$ in. diam., 140 per minute. Adjustable filling depth up to $\frac{1}{2}$ in. maximum and adjustable stroke 1 $\frac{1}{2}$ in. maximum. Fitted hopper.

MANESTY RBBS Rotary 27-punch Machine for tablets up to $\frac{1}{2}$ in. diam., 1,010 per minute. Maximum depth of fill, $\frac{3}{4}$ in. Included are 27 sets of $\frac{1}{2}$ in. diam. punches and dies, two stainless steel hoppers. Motorised 400/3/50.

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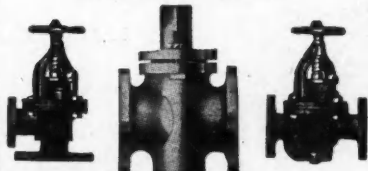
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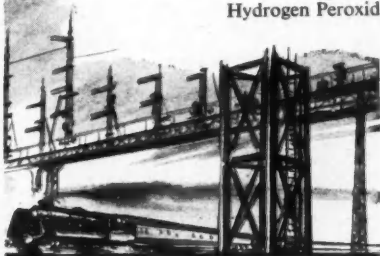


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INDEX to advertisers in this issue

	Page		Page
Alginate Industries Ltd.	Cover ii	Holmes Brothers Paint Machinery Ltd.	856
Associated Metal Works (Glasgow) Ltd.	854	Kestner Evaporator & Engineering Co., Ltd.	855
Blundell & Crompton Ltd.	Cover iii	Laporte Chemicals Ltd.	855
British Drug Houses Ltd. (The)	849	Leigh & Sons Metal Works Ltd.	856
Butterworths Scientific Publications	854	Manlove, Alliott & Co., Ltd.	807
Bryan Donkin Co., Ltd. (The)	Cover iv	Marchon Products Ltd.	809
Chemitrade Ltd.	Cover ii	Mine Safety Appliances Co., Ltd.	810
Classified Advertisements	852, 853, 854	Penrhyn Quarries Ltd.	855
Cruickshank, R., Ltd.	Cover ii	Petrochemicals Ltd.	801
Dazell Electric Welding Co., Ltd.	803	Powell Duffryn Carbon Products Ltd.	812
Elcontrol Ltd.	Cover iii	Q.V.F. Ltd.	804
Foxboro-Yoxall Ltd.	Front Cover	Richmond Welding Co.	856
General Chemical & Pharmaceutical Co., Ltd.	(The) 808	Sieber, James, Equipment Co., Ltd.	Cover iv
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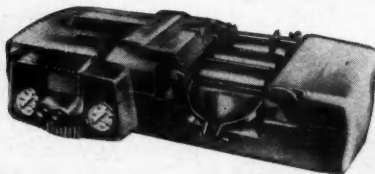


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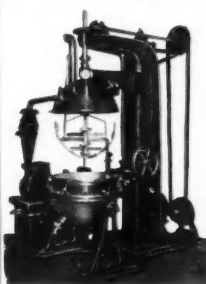
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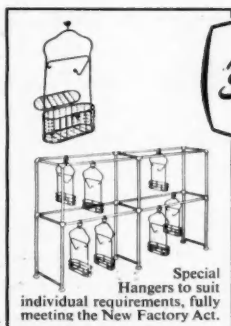
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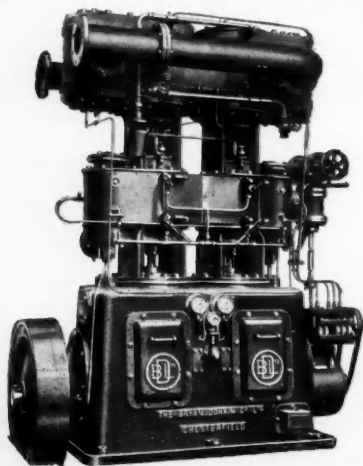
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